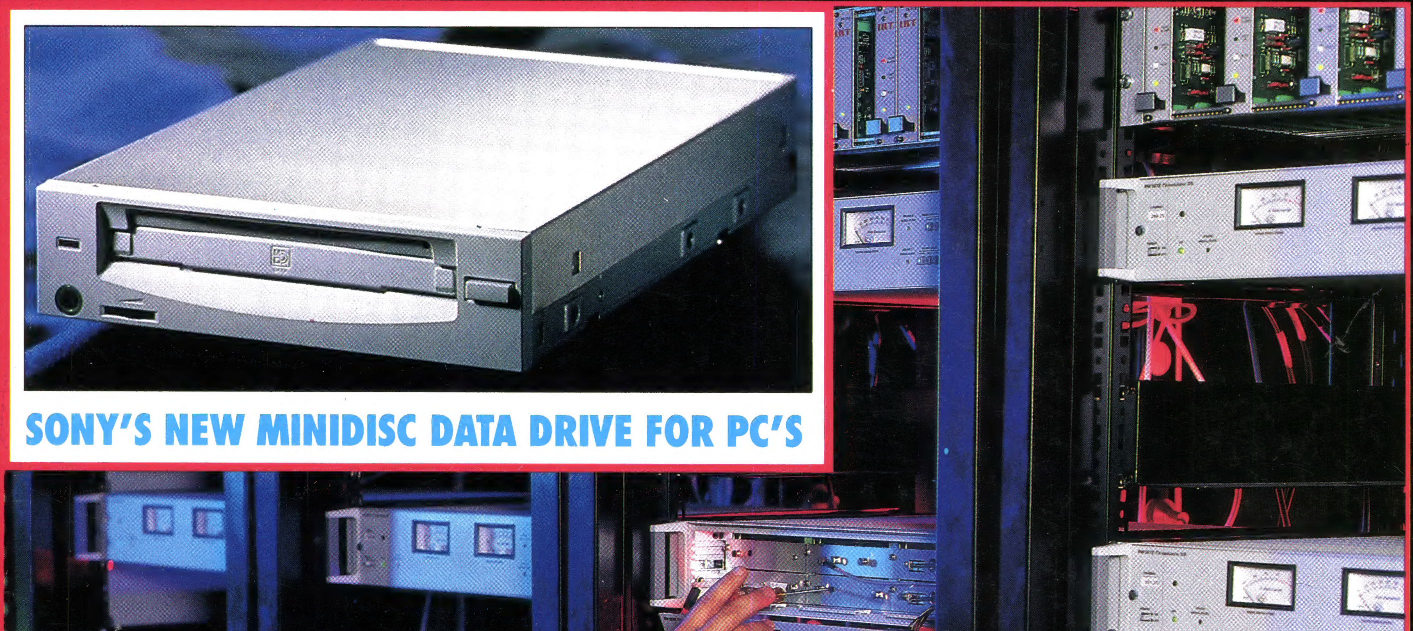
SPECIAL ANNUAL DIGEST ISSUE!

HI-FI, TV & VIDEO, RADIO & COMPUTERS!

# Electronics AUSTRALIA

WITH ETI

JANUARY 1995 $4.95*
NZ $6.95 incl GST



SONY'S NEW MINIDISC DATA DRIVE FOR PC'S

AUSTRALIAN PUBLICATION

Print Post Approved PP255003/01056

01
9 312966 123633

PHILIPS' FINAL QUALITY CHECK ON THE MELBOURNE HEAD END FOR TELSTRA'S NEW CABLE TV NETWORK

STEREO TV SOUND RECEIVER, DRY BATTERY CHARGER

FOR CHIPS...WOOD FOR CHIPS...WOOD FOR CHIPS...WOOD FOR CHIPS...WOOD FOR CHIPS...WOOD FOR CHIPS...WOOD FOR CHIPS

WOOD FOR CHIPS...WOOD FOR CHIPS...WOOD FOR CHIPS...WOOD FOR CHIPS...WOOD FOR CHIPS...WOOD FOR CHIPS...WOOD FOR CHIPS...WOOD

# We're the Hakko Iron Specialists!

## Hakko 926 Soldering Station

The Hakko 926 is a super-quick heat-up (3 sec cycle) and fast recovery iron. The built-in ceramic heater maintains temperature to within 0.5°C of the setting. Yes this is an ADJUSTABLE temperature iron covering the range from 200°C to 480°C using a full wave zero-crossing switching system. Meets MIL-STD-2000 and operates at safe 24V.
*Some people are asking $250!*

Our's are still only **$199.95**

*We keep 18 Hakko Tips in Stock plus spare parts, solder etc*

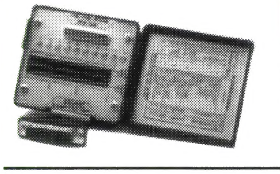
## DIC SC-7000 DeSoldering Tool ESD* Protected

- Now with 100W ceramic heater
- Sensor feedback digital temperature control
- * Special antistatic housing and zero crossover switching to protect sensitive components
- Suction/Hot air blow switch – suck for desoldering, blow for SMD removal
- Work on up to 12 layer boards

**$599** inc tax
**Call for tax-free pricing**

## Now includes FREE SMD Removal Kit Valued at $99.95

Also available for existing SC5000 and SC7000 users at $99.95

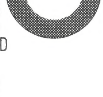


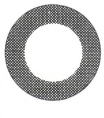
## Breakout Box

Ideal pocket sized tester for RS-232C. DB25 socket to DB25 plug. Ten LED indicators monitor status of primary signals. All pins wired and configurable.

**$59.95**

## FERRITES





| *Ferrite Beads* | | |
|---|---|---|
| FER-BN-(43)-202 | Bead 2 Hole 0.525x0.295 | $3.30 |
| FER-BLN-(73)-201 | Bead 2 Hole 0.227x0.160 | $5.45 |
| FER-FB-(43)-101 | Bead 1 Hole 0.138 OD | $0.40 |
| FER-FB-(43)-801 | Bead 1 Hole 0.296 OD | $0.60 |
| FER-FB-(43)-2401 | Bead 1 Hole 0.380 OD | $0.75 |
| FER-FB-(43)-5111 | Bead 6 Hole 0.236 OD | $0.65 |
| FER-FB-(43)-5621 | Bead 1 Hole 0.562 OD | $4.60 |
| FER-FB-(64)-101 | Bead 1 Hole 0.138 OD | $0.40 |
| FER-FB-(73)-101 | Bead 1 Hole 0.138 OD | $0.40 |
| FER-FB-(73)-801 | Bead 1 Hole 0.138 OD | $0.60 |
| FER-FB-(73)-2401 | Bead 1 Hole 0.380 OD | $0.75 |
| FER-FB-(75)-101 | Bead 1 Hole 0.138 OD | $0.40 |
| *Ferrite Toroids* | | |
| FER-FT-23-(43) | Toroid .230 OD .120 ID | $2.90 |
| FER-FT-23-(61) | Toroid .230 OD .120 ID | $2.90 |
| FER-FT-37-(43) | Toroid .375 OD .187 ID | $2.00 |
| FER-FT-37-(61) | Toroid .375 OD .187 ID | $2.00 |
| FER-FT-37-(75) | Toroid .375 OD .187 ID | $3.15 |
| FER-FT-50-(43) | Toroid .500 OD .281 ID | $2.60 |
| FER-FT-50-(61) | Toroid .500 OD .281 ID | $2.60 |
| FER-FT-50-(68) | Toroid .500 OD .281 ID | $3.60 |
| FER-FT-114-(61) | Toroid 1.142 OD .750 ID | $8.05 |
| *Iron Powder Toroids* | | |
| FER-T-25-(0) | Toroid .255 OD .120 ID | $2.05 |
| FER-T-25-(6) | Toroid .255 OD .120 ID | $2.05 |
| FER-T-37-(0) | Toroid .375 OD .205 ID | $2.60 |
| FER-T-37-(2) | Toroid .375 OD .205 ID | $1.95 |
| FER-T-37-(6) | Toroid .375 OD .205 ID | $1.95 |
| FER-T-37-(12) | Toroid .375 OD .205 ID | $3.15 |
| FER-T-50-(1) | Toroid .500 OD .303 ID | $3.15 |
| FER-T-50-(2) | Toroid .500 OD .303 ID | $3.15 |
| FER-T-50-(6) | Toroid .500 OD .303 ID | $2.35 |
| FER-T-50-(10) | Toroid .500 OD .303 ID | $3.15 |
| FER-T-50-(17) | Toroid .500 OD .303 ID | $3.15 |
| FER-T-50-(26) | Toroid .500 OD .303 ID | $3.05 |
| FER-T-68-(2) | Toroid .690 OD .370 ID | $3.60 |
| FER-T-68-(6) | Toroid .690 OD .370 ID | $2.90 |
| FER-T-106-(2) | Toroid 1.060 OD .570 ID | $9.60 |
| FER-T-106-(6) | Toroid 1.060 OD .570 ID | $11.05 |
| FER-T-130-(2) | Toroid 1.300 OD .780 ID | $11.05 |
| FER-T-130-(26) | Toroid 1.300 OD .780 ID | $11.80 |
| FER-T-157-(26) | Toroid 1.570 OD .950 ID | $11.45 |
| FER-T-200-(2) | Toroid 2.000 OD 1.25 ID | $20.00 |
| FER-T-200A-(2) | Toroid 2.000 OD 1.25 ID | $28.60 |

***Winding Wire***

| | | |
|---|---|---|
| 25gram pack | 0.2mm/70m/32B&S,0.25mm/50m/30B&S,0.4mm/20m/26B&S | $5.95 |
| 100gram pack | 0.5mm/36m/24B&S,0.63mm/24m/22B&S,0.8mm/18m/20B&S,1mm/12m/18B&S, 1.25mm/8m/16B&S | $8.65 |

# The Complete Semiconductor Listing – Part 4!

We started this listing back in October, in response to your many requests. We suggest you cut this ad out or photocopy for future reference!

| *VOLTAGE REFERENCES* | | |
|---|---|---|
| ICL8069 | 1.2V Reference | $6.90 |
| ICL8211CPA | Pgmbl Reference | $5.70 |
| ICL8212CPA | Pgmbl Reference | $6.80 |
| ICL8212CTY | Pgmbl Reference | $6.05 |
| LH0070-0H | 10.000V Bin Ref | $11.85 |
| LM329DZ | 6.9V Reference | $1.40 |
| LM334Z | Const Current SRC | $2.45 |
| LM336Z-2.5 | 2.5V Reference | $2.35 |
| LM336Z-5.0 | 5.0V Reference | $2.35 |
| LM385Z | Adj Reference | $3.35 |
| LM385Z-1.2 | 1.2V Reference | $2.30 |
| LM385Z-2.5 | 2.5V Reference | $3.00 |
| LM399H | Temp Comp Ref | $6.50 |

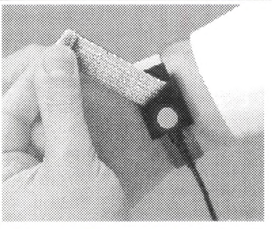
| *REGULATORS* | | |
|---|---|---|
| ICL7660CPA | See LMC7660ICN | $6.15 |
| ICL7663ACPA | CMOS Reg | $11.85 |
| ICL7665ACPA | U/Over Det | $13.30 |
| L200C | 2A Adjtbl Regulator | $4.15 |
| L4960 | 2.5A Sw Regulator | $7.50 |
| LM309H | 3 Term 5V Reg | $6.15 |
| LM309K | 5.0 Volt Regulator | $4.15 |
| LM317HVH | 3 T Adj Pos Reg | $11.90 |
| LM317HVK-STEEL | Adj Pos | $11.80 |
| LM317KC | 3 T Adjust Pos Reg | $6.70 |
| LM317LZ | 3 T Adjust Pos Reg | $0.85 |
| LM317T | 3 T Adjust Pos Reg | $1.95 |
| LM320H-5.0 | 3 T Fixed Rgltr | $10.50 |
| LM320MP-12 | 3 T Fixed Rgltr | $5.45 |
| LM320MP-15 | 3 T Fixed Rgltr | $3.20 |
| LM323K-STEEL | 3A/5V Reg | $11.85 |
| LM325N | D Track Reg 15 | $15.85 |
| LM330T-5.0 | Lo I/O Diff Rgltr | $2.15 |
| LM337H | 3 Term Neg Reg | $9.30 |
| LM337HVH | 3 Term Neg Reg | $15.20 |
| LM337HVK-STEEL | 3 T Neg | $19.15 |
| LM337K-STEEL | 3 Term Neg | $10.65 |
| LM337LM | 3 T Regulator | $2.20 |
| LM337LZ | 3 Term Neg Reg | $2.20 |
| LM337MP | 3 Term Neg Reg | $2.70 |
| LM337T | 3 Term Neg Reg | $1.95 |
| LM338K-STEEL | 5A Adj Pos | $12.40 |
| LM7805KC | See LM309K | $4.35 |
| LM7812KC | Fixed Pos Reg | $2.80 |
| LM7824KC | Fixed Pos Reg | $5.45 |
| LM7805CT | Fixed Pos Regulator | $1.80 |
| LM7812CT | Fixed Pos Regulator | $1.80 |
| LM7815CT | Order as MC7815CT | $1.80 |
| LM7824CT | Order as MC7824 | $1.95 |
| LM341P-5.0 | Fixed Pos Reg | $1.55 |
| LM341P-12 | Fixed Pos Reg | $1.55 |
| LM341P-15 | Fixed Pos Reg | $1.55 |
| LM342P-5.0 | Fixed Pos Reg | $2.00 |
| LM342P-12 | Fixed Pos Reg | $2.00 |
| LM342P-15 | Fixed Pos Reg | $1.20 |
| LM350K-STEEL | 3A Adj Pos | $12.80 |
| LM350T | 3A Adjust Pos Rgltr | $4.45 |
| LM376N | Positive Regulator | $1.15 |
| LM723CN | Positive Regulator | $0.95 |
| LM2925T | LDO Reg Del Reset | $2.55 |
| LM2575T-5.0 | Step Down Sw | $8.30 |
| LM2576T-ADJ | St Dn Switch 3A | $9.55 |
| LM2575T-ADJ | St Down Sw | $8.35 |
| LM2577T-ADJ | Step Up Sw | $11.20 |
| LM2930T-8.0 | Lo I/O Diff Rgltr | $2.15 |
| LM2931AZ-5.0 | Lo I/O Diff | $1.75 |
| LM2931CT | Lo I/O Diff Rgltr | $3.00 |
| LM2940CT-5.0 | Low D'out Reg | $2.85 |
| LM3524DN | Impr LM3524N | $3.60 |
| LM3578AN | Switch Regulator | $7.30 |
| LM7808CT | Fixed Pos Regulator | $1.80 |
| LM78L05ACZ | 3 T Pos Reg | $0.60 |
| LM78L12ACH | 3 T Pos Reg | $2.40 |
| LM78L12ACZ | 3 T Pos Reg | $0.60 |
| LM78L15ACZ | 3 T Pos Reg | $0.60 |
| LM78L24ACZ | See MC78L24CP | $0.65 |
| LM7905CK | Also LM320K-5.0 | $6.55 |
| LM7905CT | 3 T Neg Regulator | $1.80 |
| LM7912CK | Also LM320K-12 | $6.50 |
| LM7912CT | ALSO LM320T-12 | $1.80 |
| LM7915CK | 3 T Neg Regulator | $3.40 |
| LM7915CT | 3 T Neg Regulator | $1.80 |
| LM79L05ACZ | LM320LZ-5.0 | $0.50 |
| LM79L12ACZ | 3 T Pos Reg | $0.70 |
| LM79L15ACZ | 3 T Pos Reg | $0.55 |
| LMC7660IN | Sw Cap Volt Conv | $5.20 |
| LP2950CZ-5.0 | Micropower | $3.50 |
| LP2951CN | Micro Adj Rgltr | $3.70 |
| LT1070CT | 40kHz 5A Step Dn | $25.55 |
| MC3423P | Crowbar Detector | $1.30 |
| MC34063AP1 | DC - DC Ctrl | $3.30 |
| TL431CLP | Pos Shunt Regltr | $0.95 |
| TL494CN | Switching Regulator | $1.35 |
| TL497ACN | Switching Regulator | $2.70 |
| UA78S40PC:MOT | Sw Reg | $2.15 |

| | | |
|---|---|---|
| BR64-BRIDGE | 400V 6A | $2.10 |
| BR104-BRIDGE | 10A 400V | $3.60 |
| KBL04 | 400V 6A SIL | $2.30 |
| KBL3504 | 400V 35A | $5.40 |
| W04M | 400V 1.5A | $0.70 |

| *DIODES* | | |
|---|---|---|
| 1N60 | Germanium Diode | $0.65 |
| 1N3070 | 200V 150mA Sw | $0.15 |
| 1N4007 | 1000V 1A Diode | $0.10 |
| 1N4007-LF | 1kV 1A Ld Formed | $0.05 |
| 1N4148.TR | 100V 4nS Signal | $0.05 |
| 1N4937RL | 600V 1A Fast Rcvry | $0.65 |
| 1N5060 | 400V 2A Avlnch | $0.45 |
| 1N5397RL | 600V 1.5A Diode | $0.15 |
| 1N5404 | 400V 3A Diode | $0,30 |
| 1N5408 | 1000V 3A Diode | $0.30 |
| 1N5821 | 30V 3A Schottky | $1.20 |
| 1N5819 | 40V 1A Schottky | $0.80 |
| 1N5822 | 40V 3A Schottky | $1.70 |
| 1N5823 | 20V 5A Schottky | $1.30 |
| 5082-2800 | Hot Carrier Schtky | $1.70 |
| 5082-2835 | Schottky Diode | $1.65 |
| A14F | 50V/1.5A Avlch | $0.15 |
| BAV21 | 200V 250mA 50nS | $0.15 |
| BYV26C | 600V 1A 30nS | $0.50 |
| BYV27-200 | 200V 2A 25nS | $1.05 |
| BYW29-100 | 100V 8A F Rcvry | $2.65 |
| BYW29-150 | 150V 8A F Rcvry | $2.50 |
| FR604 | 400V 6A F Recovery | $1.30 |
| MBR745 | 7.5A Schottky Diode | $1.50 |
| MBR1045 | 10A 45V TO220 Shtky | $1.85 |
| MR850 | 50V 3A 200nS | $1.50 |
| MR851 | 100V 3A 200nS | $0.80 |
| MR856 | 600V 3A 200nS | $1.00 |

| *VARACTOR DIODES* | | |
|---|---|---|
| BB119 | 20-25pF Varicap | $0.50 |
| BB204G | 34-39pF Varctr | $1.05 |
| BB212 | 500-620pF Varicap | $5.00 |
| BB809 | 39-46pF Varctr | $0.75 |

***Next Month – The Final Instalment? All Our Transistors!***



## Now Stocking Anti-Static Products

We are now stocking the US-made Richmond Technology range of Anti-Static Products. Anyone dealing with servicing of static sensitive components and circuit boards will be all too well aware of the damaging effects of electrostatic discharge. The Richmond range includes –

### *Omega-Tech™ Wristband/Cord*

Top quality, adjustable, with patented design using a crochet process with 5 silver-plated conductive mono-filaments in a layer of non-conductive nylon yarn. Maximum skin contact and reliable conductivity of inner layer while the outer layer remains non-conductive. 2.5:1 elasticity ratio. Special coiled cord has a high gloss polyurethane coating and is moulded to withstand 20,000 bending cycles without failure. Cam-lock buckle is easy to adjust.
Available with 6ft lead at **$28.95**
or 12ft lead at **$32.95**

### *Field Service Mat*

Just what you service technicians have been looking for! Tough long lasting mat features a resilient outer layer that prevents tears and resists punctures and a buried conductive inner layer that guarantees consistent electrostatic discharge. Bound edges for long life. Measures 24" x 24" with two handy 8" x 12" pockets. Supplied with 12ft ground lead and fabric adjustable wrist band.
Why risk expensive equipment when this kit is only **$122.95**

### *Static Shielding Bags*

and you'll need somewhere to store parts so we are now stocking anti-static shielding bags in a range of handy sizes –

| | |
|---|---|
| 150 x 250mm (6" x 10") | $0.75 |
| 200 x 200mm (8" x 8") | $0.75 |
| 200 x 250mm (8" x 10") | $0.95 |
| 200 x 300mm (8" x 12") | $1.10 |

*Call us for Tax-Free and Volume pricing*

## TWO NEW CONNECTORS

We're always searching for those special connectors you need – and we usually find 'em!

### *CRIMP SCSI*

At last a 50 way SCSI connector for crimping to ribbon cable – much more convenient than soldering! **$10.75**

### *CRIMP RG58*

The answer to many requests – Yes we do have a chassis mounting RG58 with a crimp connection **$3.45**

## Check these chips!

### TEA 2000 PAL/NTSC Colour Encoder

Encodes colour information and provides composite video output for driving video modulator. PAL/NTSC selectable. Generates burst timing and PAL-switch function. 6 bit binary TTL compatible input generates 64 different colours. Used in Silicon Chip Pattern Generator (Nov 91) **$7.85**

### TCM3105NL Modem Chip

Single chip 1200baud FSK modem using a single 5V supply. Full/Half duplex operation. On chip group delay eq and Tx/Rx filtering. Carrier detect etc. CMOS **$16.10**

## SUPER SPECIAL ON PRINTER CABLES

***1.5metre Printer Cables are great value at $9.95, but if you mention this ad and for this month ONLY we'll give you TWO for $10.00. O.K?***

8.30am to 5.00pm Mon to Thurs., 8.30am to 4.30pm Friday.
Mail Orders add $5.00 min to cover postal charges.
Next day delivery in Sydney add $8.00.
***All prices include Sales Tax unless stated otherwise.***
*Tax exemption certificates accepted if the line value exceeds $10.00.*
**BANKCARD, MASTERCARD, VISA, CHEQUES or CASH cheerfully accepted.**

GEOFF WOOD ELECTRONICS

## Geoff Wood Electronics Pty Ltd and Semtech

**(inc in N S W)**

229 Burns Bay Road, Lane Cove West
N S W 2066 (Corner Beatrice Street)

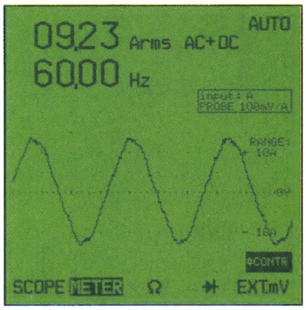
**Telephone : (02) 428 4111 Fax : (02) 428 5198**

READER INFO NO. 1

# INTRODUCING SCOPEMETER® SERIES II.

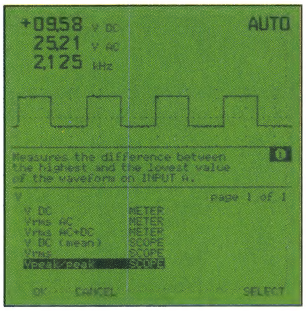
**SCOPE METER**

A 50 MHz, 2 channel, 25MS/s scope combined with a 3 2/3 digit true rms meter.



**MEASURE MENU**

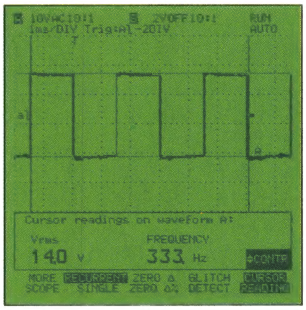
One touch gives you direct access to more than 30 automatic measurement setups.



Measures the difference between the highest and the lowest value of the waveform on INPUT A.

**AUTO SET**

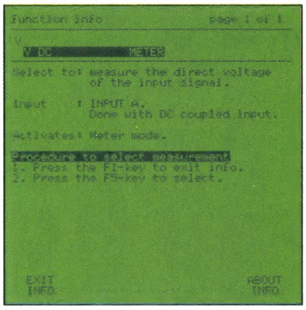
As you probe from test point to test point, ScopeMeter automatically adjusts the timebase and amplitude for a stable waveform.



Cursor readings on waveform A:

**i**

No matter what function you're using, on-line information is just a button away.



Select to: measure the direct voltage of the input signal.

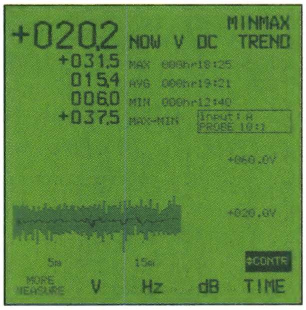
Input : INPUT A. Done with DC coupled input.

Activates: Meter mode.

Procedure to select measurement
1. Press the F1-key to exit info.
2. Press the F5-key to select.

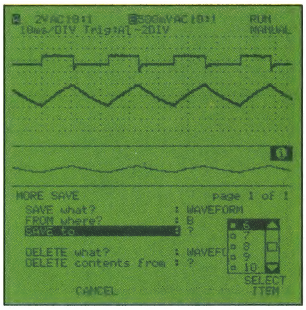
**MIN MAX**

Simultaneously graph and display Min/Max/Avg measurements over time for monitoring trends and intermittents.



**SAVE**

Large non-volatile memory stores screen images, setups and waveforms.

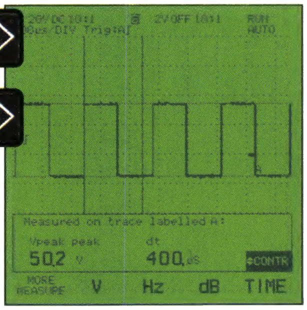


MORE SAVE page 1 of 1
SAVE what? : WAVEFORM
FROM where? : B
SAVE to : ?
DELETE what? : WAVEFORM
DELETE contents from : ?

**LEFT CURSOR**

**RIGHT CURSOR**

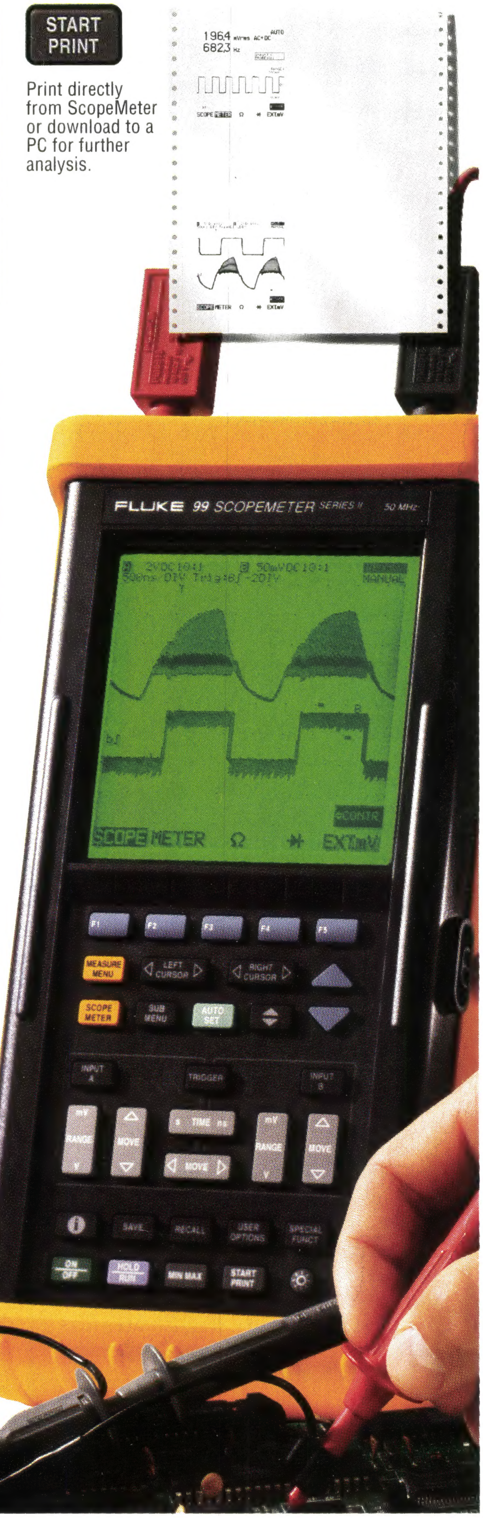
Cursors help you make more than 15 precise waveform measurements.



Measured on trace labelled A:

**START PRINT**

Print directly from ScopeMeter or download to a PC for further analysis.



## It Works Wherever You Work.

ScopeMeter Series II is a battery powered, combination scope and meter designed for measurements on-the-go. Just push the measure menu button. Select one of 30 measurements. And Series II automatically configures itself to take the reading you want. With Series II, you automatically get a good waveform. The continuous Autoset feature instantly adjusts the timebase and amplitude. And yes, we still have manual controls, but Series II is so fast and easy, why would you use anything else!

Many of you work in wet, dusty and dirty environments. Which is why Series II has a sealed, ruggedized case. And the backlit screen makes for easy readings in bright light and no-light situations.

There are four Series II models to choose from. So discover how the most popular, portable combination scope and meter can make your job easier!

Call Philips Test and Measurement on (02) 888 0416 for your nearest Fluke Distributor.

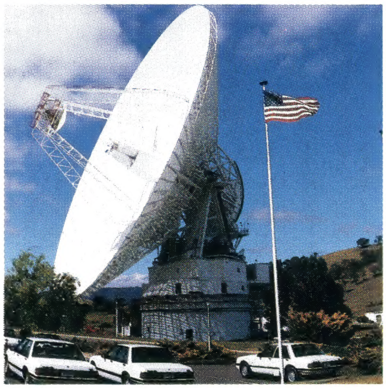
FLUKE®

READER INFO NO. 38

# Electronics AUSTRALIA WITH ETI

AUSTRALIA'S LARGEST SELLING ELECTRONICS MAGAZINE — ESTABLISHED IN 1922

### Tidbinbilla and the DSN



*Australia's Tidbinbilla earth station with its massive 70m dish antenna is a key component of NASA's Deep Space Network, used to provide communications with the many spacecraft that have been sent out to explore our solar system. Kate Doolan explains how the DSN developed, and how it operates, in her story starting on page 24.*

### Australian designed ECU

*Victorian firm Injec Racing Developments has produced its own engine control system, as Nick de Vries explains in Auto Electronics (page 48).*

### On the cover

*Our main picture shows Philips PTS project engineer Andrew James performing a final quality check on one of the 23 racks of the Melbourne Headend for Telstra's cable TV network (the broadband information 'superhighway'), at Philips' Moorebank (NSW) facility. The Headend has now been delivered and commissioned by Philips. (Courtesy Philips Electronics Australia.)*
*Inset picture: Sony's long awaited MD Data Drive, just about to be released, which allows personal computers to take full advantage of MiniDisc's 140 megabytes of read/write data storage capacity. (Courtesy Sony Australia.)*

## Video and Audio

8 **WHAT'S NEW IN VIDEO & AUDIO**
*The latest products, plus what might be ahead in the coming year...*

11 **ONKYO'S TX-SV919THX A/V SYSTEM**
*Peter Phillips reviews this home theatre amplifier, based on Lucasfilm's THX system*

14 **THE CHALLIS REPORT:**
*A look at the CSIRO's development of the 'A4' digital audio processor chip*

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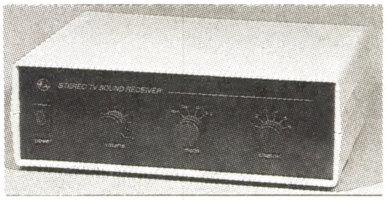
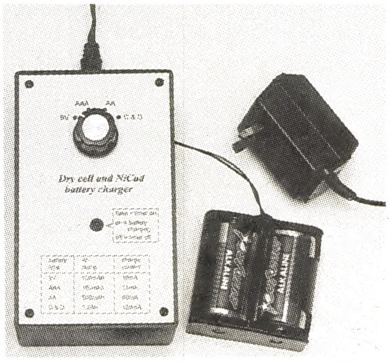
### Low cost stereo TV sound



*Keen to hear the full stereo sound from movies broadcast on TV, but can't afford to junk your existing telly and buy a big stereo model? One of our projects this month is a new Stereo TV Sound Receiver designed just for you. Your TV continues to handle the pictures, while the Sound Receiver provides the stereo sound. It even includes a simple surround sound decoder, with rear, front centre and subwoofer outputs! The article starts on page 56...*

### Charger for dry cells



*The makers of alkaline cells and other dry batteries warn against trying to re-charge them, but over the years it's been found that with the right techniques, it can be done successfully — and recently commercial chargers have become available. Our Technical Consultant Peter Phillips has been experimenting with a low cost charger design of his own, and getting good results. He describes the design in his article starting on page 70.*

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**ELECTRONICS AUSTRALIA** is published by Federal Publishing Company a division of Eastern Suburbs Newspapers Partnership, which is owned by
General Newspapers Pty Ltd.
**A.C.N. 000 117 322,**
Double Bay Newspapers Pty Ltd.
**A.C.N. 000 237 598** and
Brehmer Fairfax Pty Ltd.
**A.C.N. 008 629 767,**
180 Bourke Road, Alexandria, NSW 2015.
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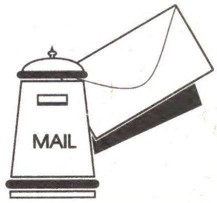
No part of this publication may be reproduced in any way without written permission from the Publisher or the Managing Editor.
Printed by Macquarie Print, 51 - 59 Wheelers Lane, Dubbo NSW, 2830, phone (068) 843 444, for Federal Publishing Company.
Distributed by Newsagents Direct Distribution Pty Ltd, 150 Bourke Road, Alexandria, NSW 2015; Phone: (02) 353 9911.
**ISSN 1036-0212**
*Recommended and maximum Australian retail price.
The Australian Publication emblem on the front cover of this magazine is there to signify proudly that the editorial content in this publication is largely produced and edited in Australia, and that most of the advertisements herein are the products and services available within Australia.

# LETTERS TO THE EDITOR



## PC-based PLC

Many thanks for publishing my article on a low cost PC-based PLC. Having read the article I would advise the following errors need correction.

1. On page 97 the first two lines of the BASIC program listing should be:
   10 CLS:REM Decoding the input conditions.
   100 X = INP(889)
2. Also on page 97, the overlay diagram (Fig.4), shows the incorrect orientation of the pink bottom layer. The pink layer should be flipped top to bottom to align correctly with the top layer showing the parts placement.

Further to the correction noted in 2 above, it may be advisable to warn constructors making their own printed circuits to carefully orient their Positive or Negative artwork relative to the printed circuit board to achieve the correct pattern orientation, otherwise whilst it would be possible to mount all the parts, the connections in J1 and J2 will be incorrect.

John Holliday,
Nathan, Qld.

## Fander robots

We would sincerely like to thank Electronics Australia for featuring the Fander, our latest mobile robot product, on your front cover; and to thank Tom Moffat for his story in the November 1994 issue. Fander is 100% Australian designed and manufactured, which we are very proud of, and it has already been exported to Germany, Norway, France, India, Singapore, the USA and Malaysia.

For the most part Mr Moffat's historical commentary is accurate, but I would like to add some comments that may be useful to anyone reading your story.

Mr Moffat makes a strong analogy with the Tasman Turtle and the Fander. The Tasman Turtle was developed in 1979 to assist in the development of problem solving skill in school children after years of development of the Logo language at MIT by Professor Seymour Papert and our Turtles were refined to maximise this capability with the help of the Elizabeth Computing Centre, Professor Sale at the University of Tasmania and with the endorsement of Professor Papert himself while at a seminar at Latrobe University in the early 1980s.

In 1979 there were no other mobile robots, and in retrospect the Tasman Turtle can be seen as the world's first successful, mass produced mobile robot product. Many of our sales were to users not interested in the educational purpose, but desiring a research platform, a hobby robot or a vehicle for other purposes, so our Turtles gradually evolved a sophisticated array of ancillary functions, many identified by Mr Moffat, but also including speech recognition and control, a global compass and internal orientation, for these customers.

Fander is not an educational robot in the same sense as the Turtle and anyone considering using Fander as a sort of upgraded turtle would be disappointed. Since 1979 mobile robotics has come a long way with numerous real and practical mobile robotics products in use for tasks in several areas such as factory automation, commercial floorcare and autonomous security. Many of these products have been developed by Denning Branch.

Fander specialises in presenting to a serious researcher or robotics lecturer a vehicle with demonstrations of most of the currently known autonomous technologies. These are presented in an interactive format where solutions to multiple algorithms are available, each suggestive of one of the autonomous technology paradigms. Such things as line, wall and beacon tracking, mapping with environmental sensors and parametric mapping.

Denning Branch, in several of its international product contracts, has implemented fully autonomous robotic technologies into such things as robotic security guards, robotic TV camera pedestals, robotic luggage and household vacuum cleaners.

Our proprietary technologies in these devices are the world's best. For example, our UTV-100 automatic guided vehicle (AGV) introduces for the first time an old industrial product that is enhanced by the addition of obotics. The UTV-100, instead of folowing wires on the floor, uses a sophisicated laser based global positioning ensor and guidance system developed y us.

The BiC at Milford, Connecticut, for xample uses one of these to carry tacks of ink cartridges through the ength of their factory, which it has een doing four times a day, six days a veek for almost two years.

Fander software, rather than being mperfect, as suggested by Mr Moffat, s a reduced set of the Denning Branch technologies presented in exactly the format required by the researcher or robitics instructor. Even following or line following is a very complex task for a mobile vehicle, and Fander offers suggestions as to what these problems are, various solutions and an interactive environment to practice and then explore the concepts described in the comprehensive user's manual.

If our customers want a robust, faultless solution, they may want to purchase our commercial products. At a recent conference held by NASA in Houston, Mr Branch presented some of the Denning Branch fully autonomous mobile robotics technologies that were developed in Tasmania in 1984 - 1986 through an AIRDIB grant and TDA support.

He was invited to Titusville by their Robotics Division. Rather than a spin-out of NASA technology, the meeting resulted in moves to initiate a spin-in of our technology for NASA applications.

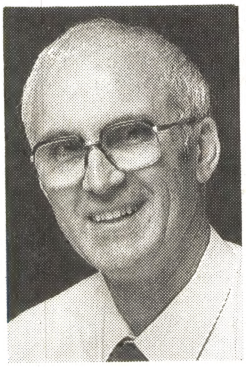
So just as the Tasman Turtle was a huge international success due to its meticulous attention to the needs of the particular application, so has Fander started generating the same international excitement.

Professor Jarvist's laboratory at Monash University, through Dr Lindsay Kleeman has just purchased their second Fander and rather than being an expensive product at US$5500, it is approximately half the cost of any other research product in its class.

Ms Denise O'Hare,
Op. Mgr,
Denning Branch Mobile Robotics, Inc
Pittsburgh, Pennsylvania, USA.

**Letters published in this column express the opinions of the correspondents concerned, and do not necessarily reflect the opinions or policies of the staff or publisher of Electronics Australia. We reserve the right to edit letters which are very long or potentially defamatory.**

# EDITORIAL VIEWPOINT



## *Cellular and satellite phones: a wider perspective*

Welcome to our first issue for 1995. We've all worked hard to pack considerably more into this Annual Digest than in a standard issue, and I'm sure you'll find plenty of interesting reading.

Before you turn past this page, though, I wonder whether you've given much thought to the full impact of cellular telephones, and the satellite phones that are just coming over the horizon. I don't mean just the broad technical achievements that these embody — of which most readers of *EA* are no doubt aware, and probably like me find it very impressive. No, what I'm talking about here are their long-term benefits, for more people than we tend to imagine.

The very rapid growth of cellular phones in Australia has made most of us aware of their benefits to people like self-employed professionals, trades and sales people, who are now able to maintain reliable communications despite being on the move a lot. But I guess we're all aware of the way these phones have also become status symbols, leading to the often-apt description 'poserphone'. I must confess I've been irritated by car drivers roaring along with a phone pressed to one ear (and only one arm available to control the car), and also by young yuppies conducting an earnest conversation while strutting back and forth along the footpath.

It's all too easy to let these inevitable abuses colour one's thinking about the wider benefits of cellular phones, and dismiss the coming satellite phones as simply a more expensive and pretentious version of the same status symbols. In the future, it's quite possible that taken together, cellular and satellite phone technology could be seen as the most important development in national and international communications — even more important than the invention of the telephone itself, automatic exchanges or the submarine cable.

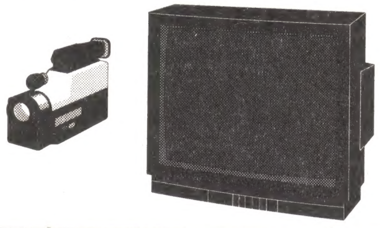
Why? Because they can enable developing countries to establish a national communications network and international links far more rapidly, and at a far lower cost than using traditional copper cable or even fibre-optic cable.

Although we in the developed countries take telephones, faxes and modem communications for granted, it's easy to forget that in most of Asia and well over half the African continent (accounting for most of humanity), there is currently less than *one* telephone line per 100 people. In fact according to the 1994 ITU Telecommunication Development Report, only a small proportion of the world's people live in countries where there are more than 20 lines per 100 people — countries like Australia, the USA, the UK, Japan, France and Scandinavia.

If cellular and satellite phone technology is used to allow people in developing countries to begin enjoying the level of communications we enjoy, that will endow them with all the justification anyone could ask for, don't you think?

**Jim Rowe**

# What's New in VIDEO and AUDIO



## What will we see in the year ahead?

Each year in the January issue, we briefly review what has happened in the fields of audio and video during the previous 12 months, and try to predict what you might expect during the following year. It's that time again, so here goes:

Roughly half of our predictions for 1994 turned out to be right, as it happens. We said we doubted if Pay-TV would finally get going in Australia, and from a practical point of view this is still true. The same applies to digital TV and HDTV, which we predicted probably wouldn't get going either. (Not that it gives us any satisfaction, to have been right with such negative predictions.)

We were a bit premature with our predictions that video CD's and consumer CD-i's would take off, though. Although both the players and the discs have been released in the USA and Europe, the closest we got here was a preview unit that Louis Challis was able to review for our December issue. The full Australian release now looks to be likely in the next couple of months. The first units seem to be using MPEG-1 video, though; the improved MPEG-2 versions probably won't appear until at least the end of 1995.

Another area where we were less than successful was our prediction that 1994 would be the year that one of the two new compressed digital audio media, DCC and MD, would finally blossom in the marketplace and trounce its competitor. So far this hasn't happened, with both of them virtually languishing on the sidelines. Neither has withered and died, but neither has gained much market acceptance either.

Last year we stuck our necks out and predicted that MD would be the ultimate winner, because of its faster random-access track accessing, potentially greater reliability (due to optical readout) and also its appeal as a compact 140-megabyte data storage medium for PC's. We're still inclined to think that this will happen, but perhaps not before the latter part of 1995.

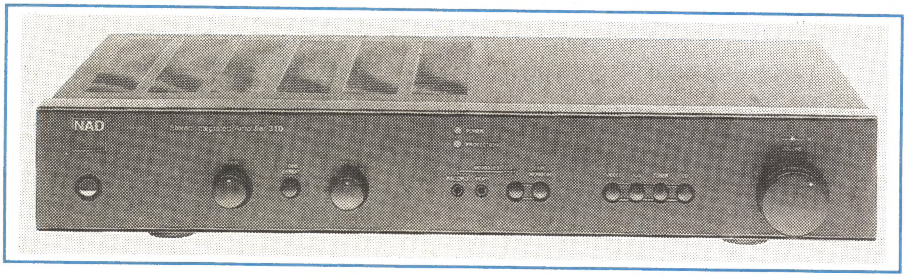
Well then — what else do we think we can see in the crystal ball, for the rest of 1995? Not a lot, actually, as it seems to be even more cloudy than usual; the consumer electronics industry seems to be taking longer than expected to pull out of the recession.

One trend that does seem likely to continue is the increasing tendency for TV receivers to 'go digital' — not in the sense of being able to receive digital TV transmissions, but in the sense that traditional analog circuitry and adjustments are being replaced with the digital equivalents. This is producing sets that are generally more reliable and more stable in performance, as well as achieving higher standards of picture resolution and linearity.

## New 'Super Simple' amplifier from NAD

The new 310 is the first amplifier to benefit from NAD's innovative 'Super Simple' circuit design topology: employ fewer components and deliver increased efficiency.

Rather than adding facilities and features to an existing design, NAD has chosen to trim off all the 'fat' and instead optimise the design and components directly related to performance. The 310 exemplifies this; no loudness control, mono buttons, phono section, or other secondary bells and whistles — just the absolute necessary controls needed for day to day operation. Thus, the new NAD 310 is claimed to redefine the standards against which amplifiers will be judged, much in the way the legendary NAD 3020 did when it was first released 15 years ago.



NAD's Super Simple concept is a totally new amplifying circuit topology, claimed to achieve high current capability at a yet lower cost than traditional 'push-pull' designs. The circuit comprises a single ended, pure Class A driver stage, in turn driving a complementary set of output transistors — one 'Logic Level' N channel MOSFET, the other a state of the art PNP bipolar transistor. Through careful and limited local feedback around these transistors, their characteristics are accurately matched.

The result is an amplifier with approximately half the number of components and an increase in efficiency of almost 20% when compared to amplifiers of simple price or specification. In the 310, this reduction allowed the use of higher quality components, such as an ultra-low loss, silicon steel toroidal power transformer, MOSFET power transistors, metal film resistors, and more.

Although modest in its continuous power output of 20 watts in eight ohms, the NAD 310 can deliver a massive amount of current (over 20 amperes) normally associated with power levels double or triple that of the NAD 310, giving it the ability to drive very complex loudspeaker loads.

For further information circle 181 on the reader service coupon or contact Marantz Australia, 3 Figtree Drive, Homebush 2140; phone (02) 742 8322, or fax (02) 764 3074.

Much the same seems to be happening with VCRs, although here the move to a true digital system seems to be proceeding faster than with TV receivers. Presumably this is because manufacturers foresee that once video CDs become available, the market for traditional analog VCRs may well begin shrinking. We may therefore see 'full digital' domestic VCRs appear before the end of this year.

Large-screen and 16:9 format TVs still seem to be steadily growing, as part of the tendency for people to set up 'home theatre' installations. However the cost of large-screen and wide format sets is still a significant barrier, and because of this we don't expect any dramatic developments in this area.

Will we see digital audio broadcasting (DAB) in Australia, during 1995? It's possible, perhaps, but we'd be surprised. Developments overseas are still proceeding fairly slowly, and in view of Australia's small market size we aren't likely to see DAB until it's established in the USA and Europe — as with so many other new technologies.

Presumably 1995 *will* finally see us get Pay TV, using either (or both) optical/coaxial cable or satellite/MDS delivery. One of the systems may even be fully digital, in which case the foundations will at last be laid for the future 'information superhighway'.

We're just hoping that 1995 will bring a few more developments than did 1994. Last year was fairly quiet — a bit more excitement in the video and audio area would be welcome.

## New 'Classic' speakers from Jamo

Jamo's new Classic series of loudspeakers comprises three elegant models suitable for diverse decors and musical tastes. Jamo Classic 4, 6 and 8 are well suited for quality conscious music lovers who also demand an aesthetically pleasing speaker. With their slim enclosures and choice of bookshelf or floor standing models, the new speakers are designed to blend harmoniously with modern interiors.

Features of the new models include:

- slim cabinet design, resulting in wide dispersion within the listening room and a minimum of sound colouration from the cabinet itself.
- twin bass drivers for high sensitivity, accurate transient response and high power handling.
- specially designed moulded rubber woofer mounting ring, to reduce

## New CD player has enhanced sound

Featuring a new look livery, the new Onkyo DX-730 CD player features a centre mounted display and vibration reducing CD tray.

The DX-730 also introduces Onkyo's impressive FPCS system in an affordable CD player.

Originally employed in Onkyo's high end CD players, FPCS (Fine Pulse Conversion System) is a novel digital signal processing system claimed to give CDs the same 'warmth' and 'musicality' which purists often regarded as being possible only in analog systems.

Based on technology borrowed from recent advances in computer graphics, FPCS reduces ringing during interpolation and makes a more accurate computation of any missing signal data. The DX-730 employs single bit converters that are claimed to eliminate the zero-cross distortion and non-linearity that plague conventional CD players, especially at low signal levels.

Features of the DX-730 include: eight times oversampling digital filter; optical digital output; 36 track song memory; peak search, time edit, shuffle play and five repeat modes; and a headphone jack with volume control. The DX-730 is supplied complete with an RI compatible remote control and has a recommended retail price of $659.

For further information circle 182 on the reader service coupon or contact Amber Broadcast, 5 Skyline Place, Frenchs Forest 2086; phone (02) 975 1211 or fax (02) 975 1368.

vibration from travelling from the cabinet to the woofer and vice-versa.

- 25mm of soft dome tweeter with magnetic oil (ferrofluid), specially coated textile diaphragm and computer designed front face plate.
- uniquely profiled 22mm MDF (custom-wood) front panel designed to significantly reduce colouration and resonances from the cabinet.
- computer designed interior bracing (Classic 6 and 8) for even further reduction of cabinet resonances.

Jamo Classic 4 is a compact loudspeaker featuring twin 133mm woofers, designed to be placed on a bookshelf or dedicated loudspeaker stand. The D'Appolito configuration (woofers mounted above and below the tweeter) allows the speaker to integrate well in the listening room. RRP is $999 per pair.

Jamo Classic 6 is a two-way floor standing speaker featuring twin 133mm woofers, a narrow profile and attractive proportions. RRP is $1399 per pair.

Jamo Classic 8 is a three-way floor standing design of high sensitivity and power handling. Classic 8 features twin 165mm bass drivers, and a 133mm midrange driver which covers the frequency range of 700 - 2500Hz. RRP is $1799 per pair.

For further information circle 183 on the reader service coupon or contact Scan Audio, 52 Crown Street, Richmond 3121; phone (03) 429 2199 or fax (03) 429 9309.

## Two new stereo large screen CTV's

Panasonic has launched two new stereo colour TV's –– a 68cm and a 59cm model. Both are produced in Australia at MELCOA, Panasonic's television factory at Penrith on the outskirts of Sydney.

The TC-29V50A 68cm unit was recently launched to appeal to consumers who want a large screen television with stereo sound. With its latest technology, 'Super Flat and Black' picture tube, its stylish cabinet and all round stereo sound, the TC-29V50A is very affordable in the large screen category.

An optional stand which has been designed to blend in with the television is also available.

The new remote control, which is included with both new models, fits neatly into the palm of the hand and is Panasonic video cassette recorder compatible.

The second model is the TC-25V21A with a 59cm 'Super Flat and Tinted' screen and a 'Dome Sound System' for enhanced stereo sound.

Included in both models is an 'Oscar Tuner' which increases the channel capacity for future expansion of television services. Both also provide two audio/visual input terminals, a Super-VHS video terminal, an audio/visual Out terminal, NTSC playback capabilities, on-screen display, 30/60/90 minute off timer and VCR operational functions on the television remote. These features provide the versatility to make the CTV's the centre of an entertainment system.

For further information contact the Panasconic Customer Care Centre on (02) 132 600.

## Yamaha 16-channel digital mixer

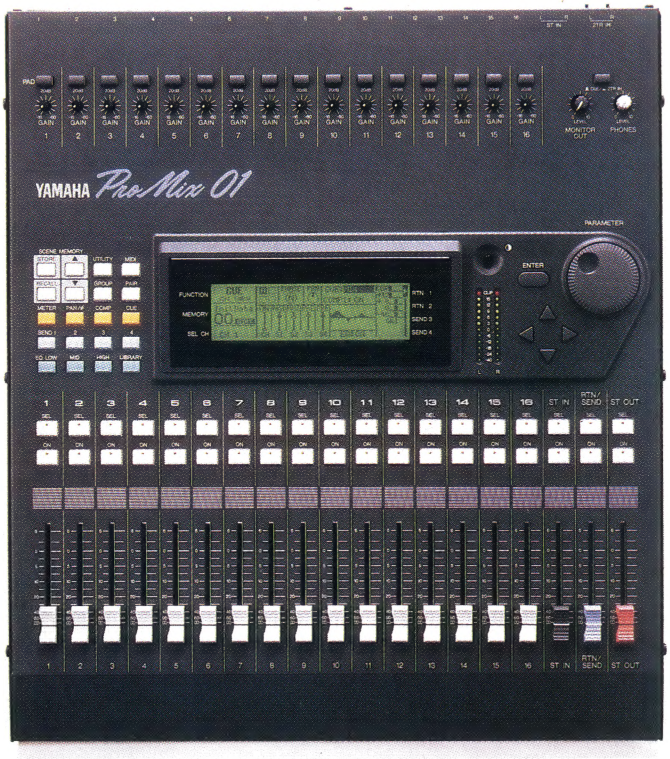
Yamaha Music's new ProMix 01 Programmable Audio Mixer is an extremely compact, fully digital 16 channel unit featuring moving faders, full MIDI control, two internal digital effects processors, three assignable stereo compressors and total instant recall. With all these features and facilities, Yamaha says it would justify a $40,000 price tag, yet the ProMix 01 carries an RRP of only $3995.

ProMix 01 represents an entirely new approach to audio mixing. While interfacing to the outside world via conventional analog inputs and outputs, all internal routing, processing, equalisation and mixing is performed in the digital domain. Digital conversion is performed at 20-bit resolution, with 64 times oversampling on inputs and eight times oversampling on outputs, internal processing is 24-bit, with 32-bit for EQ, yielding a dynamic range of over 100dB.

ProMix 01 provides 16 channels of audio mixing with eight balanced inputs on XLRs, each with switchable phantom power, and eight balanced inputs on tip/ring/sleeve jacks. An additional stereo input is provided for a stereo source. Stereo mix outputs are available as digital S/PDIF and analog balanced at +4dB, and unbalanced at -10dB. All input channels, effects returns and stereo outputs feature linear, motorised faders with four fader groups for single fader control of any number of assigned channels.

Input channels, effect returns, and the stereo outputs all feature three band full parametric equalisation. In addition to standard operation, EQ settings may be stored in a library and recalled as required. A library of unique EQ presets designed for specific applications and instruments is provided with ProMix 01.

When ProMix 01 is connected to and controlled by a MIDI sequencer, all console parameters can be controlled in real time via MIDI for total mix automation. All parameters, including effects, EQ and dynamics can be controlled precisely and efficiently.



ProMix 01 is available from authorised Yamaha dealers across Australia. For further information or the name of your nearest dealer, please contact Yamaha Music Australia on (03) 699 2388. ❖

### Peter Phillips reviews the new

# Onkyo TX-SV919THX A/V THX system

While reviewing the new Onkyo THX home theatre amplifier system, Peter Phillips found more than he bargained for. Has digital audio processing finally come of age, he asks?

The ongoing battle between the cinema and home entertainment industries has spawned a new term: home theatre. It started about five years ago when the Dolby Pro-Logic decoder became available as a consumer product. When I last upgraded my sound system, I added a Pro-Logic decoder with centre and 'effects' speakers. However I rarely use this decoder for listening to music, as its various sound 'modes' don't enhance the sound — they just make it different.

So when I had the opportunity to review the Onkyo TX-SV919THX audio-video-control-tuner-amplifier (as Onkyo call it), I figured it to be a home theatre product only, and not really for hifi. My interest was therefore on the performance of its THX processor. Caringbah HiFi, who supplied the review unit, also loaned me a video disk player and unlimited access to their video disk swap club, giving me quite a range of Dolby Pro-Logic encoded video/audio material for this review.

## The THX system

In his *EA* May 1994 review of the Kenwood KC-X1/KM-X1 THX home cinema combo, Louis Challis describes the THX system in some detail. Basically, THX (Thomlinson Holman eXperiment), is a process developed by Lucasfilm which enhances a Dolby Pro-Logic encoded sound track by further processing the output from a Pro- Logic decoder. Note that THX is not an encoding process for a movie soundtrack.

The THX system was originally developed for movie theatre use, but Lucasfilm have since produced Home THX, which is the system in the Onkyo A/V unit. Fig.1 shows the block diagram of a THX system.

There are six outputs from the THX section: left, centre and right, surround left and right channels and a subwoofer output, which is claimed to pass the bass frequencies of all channels to the subwoofer. It's arguable whether this is unique to THX.

Apart from giving two effects channels (Pro-Logic has one), the decoder is claimed to give a more natural tone by cutting back the bright sound required in a cinema, as well as producing a uniform sound envelope, with a smooth merge between the front and rear soundfields. It's also claimed to give more intelligible dialogue, and a more accurate sound position. In other words, the system is designed to give cinema-like sound in a small room.

However, because movie-quality surround sound needs more than a THX processor, Lucasfilm has issued standards for speakers, amplifiers and so on. For instance, a speaker with the THX logo means it's certified by Lucasfilm as being able to produce a sound pressure of 105dB without distortion. THX certified surround speakers have dipolar radiation characteristics (see Fig.2).

So to get the ultimate system, Lucasfilm advises buying equipment from a THX certified dealer, and to only purchase THX certified equipment. The Onkyo A/V unit, as you would expect, is THX certified.

## Onkyo's TX-SV919THX

Unlike Kenwood, whose THX system is in two units (decoder and amplifier), Onkyo opted for a single unit measuring 455 x 190 x 425mm. Contained therein are two 100W (110W in bypass mode) power amplifiers for the front speakers, a 100W amplifier for the centre speaker, two 50W amplifiers for the surround speakers, an AM/FM tuner, 12 input select pushbuttons, a range of controls and a large fluorescent type display.

Six pushbuttons are labelled Video 1 to Video 6 (A/V inputs), and the rest are for CD, phono, the internal AM or FM tuner and two tape decks. The six A/V inputs accept stereo audio and video (RCA and S-Video), and three also have connectors for stereo audio-out and

# Onkyo TX-SV919THX A/V THX system

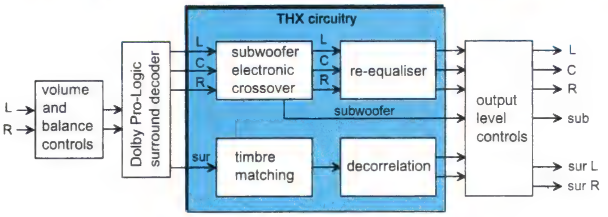


*Fig.1: The THX circuitry further processes the output of the Pro-Logic decoder.*

video-out, allowing VCRs to be interconnected for dubbing purposes. Two video monitors (one S-Video) can be connected to the unit.

Six A/V inputs might seem a lot, but any of them can be used for audio only, and the flexibility of being able to switch up to six video signals is a great feature.

The Video 4 input has an optical fibre input, for connection to either a video disk player or a CD player. I used this input for the CD player. The inputs for Video 5 are on the front panel.

The rear panel has a large number of connectors, including 51 RCA connectors, 20 speaker terminal posts (4mm), nine S-Video connectors and a miscellany of others. To cater for future developments, there's also a 25-pin 'D' connector for an external digital surround decoder.

Although I had no real difficulty connecting the unit into my system, multi-way connectors, like 5-pin DIN connectors would help reduce the rat's nest of cabling. As it stands, connecting or removing the unit is quite a task.

With the front control panel closed, apart from the display and on/off switch, all you see are the volume control and the input select buttons. The control panel swings down at the push of a button, and hidden lighting makes the controls easily visible.

Most of the controls on this panel are for the AM/FM tuner, as virtually all other functions of the unit can be controlled by six pushbuttons, either at the control panel or from the remote control. The display shows every operational aspect of the unit, and text that won't fit is scrolled across the display.

But the easiest way to set the many functions and settings is from the TV screen. Five keys on the remote control let you operate from an on-screen menu. Graphics give an easy-to-use interface, allowing complete on-line control of individual speaker output levels, simulated room size and shape, reverb level, effects level and so on.

## Measurements

Although the main power amplifier is rated at 110W per channel (no surround), I measured close to 147W per channel (power just before clipping, both channels driven equally into an eight-ohm resistive load). Impressive, and quite a bit above specifications.

The centre channel amplifier gave around 145W, compared to its specified 100W, and the surround amplifiers each delivered 75W, rather than their rated 50W. However, while not obvious on the 'scope, it's likely the quoted distortion figures would be worse at these power levels.

Frequency response for the main amplifier was flat to 20kHz, with an increase in the output level occurring somewhere between 30kHz and 40kHz, depending on the output level.

However, the real test for me was whether the unit could drive my Magnaplanar MG IIIA front speakers. These speakers need a lot of power to get a decent sound level, and I normally drive them with an NAD 2600A, 150W per channel main amplifier.

My test pieces included the final bars of Mahler's Resurrection Symphony, (Telarc CD-80081/82), and the theme from *Terminator 2* (Telarc CD-80342). The Onkyo acquitted itself well, but when the volume was set to 0dB (which is very loud), I was able to hear distortion in the highly percussive parts of Terminator 2. However, this is an extraordinary piece, with a dynamic range well beyond most recordings.

The Mahler sounded fine, even though in the loudest parts I could see clipping on the 'scope. The output voltage across the speaker terminals was limited to around 90Vp-p, compared to 130V from the 150W per channel of the NAD 2600A. But without doubt the Onkyo equals or outperforms any other 100W amplifier I have used with these speakers, including an NAD 2400 100W amplifier. Given that Magnaplanar speakers are a special case, I'm convinced that the Onkyo has more than enough grunt to satisfactorily drive most of today's speaker systems!

## Listening tests

While I've lived with a surround sound system for some years, I decided that because of its subjective nature, this review should involve as many people as possible. To that end, at least 20 audiophiles, musicians and sound enthusiasts participated in listening tests of the unit.

The participants' ages varied from 17 to 70, and about 70% of the subjects were male. I conducted two tests: watching movies in THX mode and listening to music using the Onkyo's various sound modes.

We found the THX surround sound to be so effective that everyone commented at some point during a movie. "Listen to THA-A-AT!", or "Wow!" were typical comments. No one went away unimpressed; interesting when you remember that the audience is 'soundwise', and that we weren't using THX certified speakers.

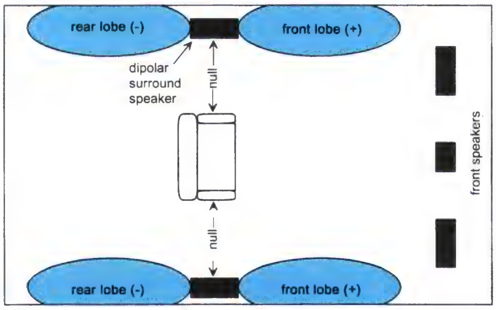
We also found the THX sound image to be more accurate compared to Dolby Pro-Logic, and there was a feeling of being enveloped in sound, rather than just hearing sound from the front and rear. My wife commented that at last she could hear the surround effects...

We also compared THX certified dipolar surround speakers to my conventional rear speakers. Dipolar speakers are placed as shown in Fig.2 and give sound fields that create a null along the seating axis. My test for these speakers was *Hunt for Red October*. Their effect is quite subtle, to the extent that you might wonder if they are even working. But when called on, dipolar speakers give a very real surround effect.

However, I preferred my rear speakers, mainly because I wanted optimum sound effects for music. And what effects!

It didn't take me long to realise that here was one of the finest digital sound

*Fig.2: A THX system with dipolar speakers gives a more realistic surround effect, as you are only aware of these speakers when the sound environment requires it.*



processing systems I've ever heard. Being an opera buff and concert goer, I know the sound of the real thing.

For instance, I was able to create in my music room the the concert hall of the Sydney Opera House. Everyone who heard it agreed that this effect enhanced the listening experience. Musicologist, director of the Condon Collection range of CDs, and very regular concert-goer Denis Condon remarked "What a wonderful experience".

Others, including pianist Phillip Scott (from the ABC's *Three Men and a Baby Grand*) had similar comments. We also tried various pieces from a Belart Sampler disk, 450071-2 (cost $4.95), which has 17 tracks (orchestral and operatic), originally recorded between 1959 and 1974. Again we were enthralled, proving that the system performs equally well with low cost recordings.

Organ music, like David Drury's 'Tannhauser: Pilgrims' Chorus' on the Sydney Town Hall organ (ABC Classics, 432527-2) is not only amazing, it's spectacular. You feel as if you're there in the hall, with waves of sound passing around the room, completely enveloping you.

The remarkable thing about the various sound effects is their realism. Quite a few listeners were able to identify the effect (stadium, night club, open air etc.,) just by listening to it. CDs recorded in surround sound produce an almost unbelievably wonderful sound, and I settled on the 'Theme from Rocketeer' (Telarc CD-80342) as a sample piece for visitors.

## Bad points

I have very few gripes with this remarkable unit. Radio station storage and selection is rather complicated and the AM tuner is typically poor, although the FM tuner is excellent. The manual is badly laid out and is sometimes quite difficult to follow. An index would help, although it has many excellent illustrations. Fortunately, operating the unit is relatively intuitive and you don't need to use the manual a great deal anyway.

I'm surprised there's no cooling fan, as the unit runs at a reasonably warm temperature, which in a confined space could cause overheating. The manual doesn't mention temperature or overload cutouts, and the only reference to ventilation is a single paragraph buried in a part of the manual many people will ignore.

Although a minor grumble, when the volume level is changed, the unit's display changes to show VOLUME = ?dB, with the dB value changing as the volume control moves. This means you can't unobtrusively change the volume unless you turn the front panel display off (it has four brightness levels, including completely off).

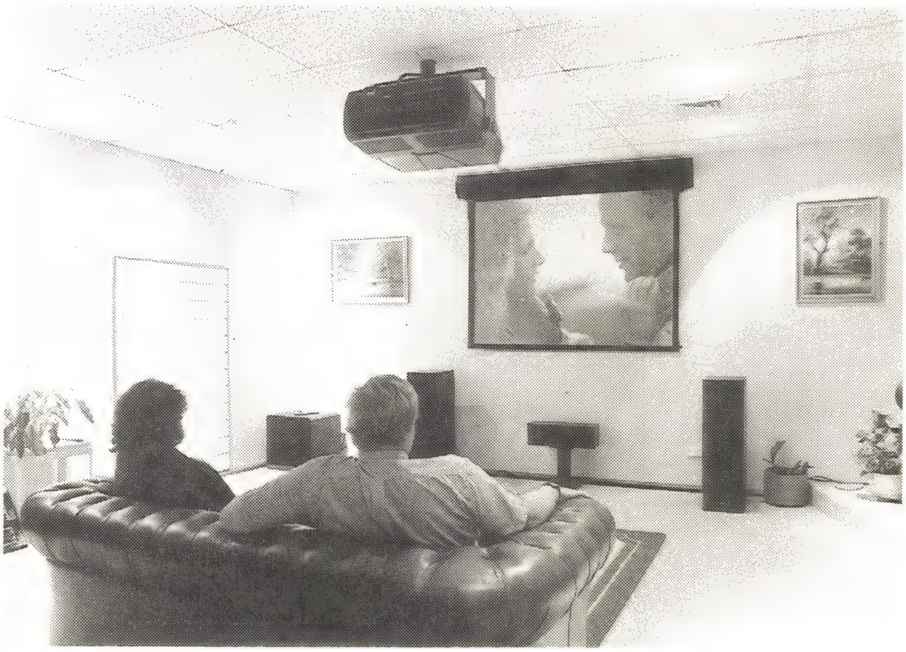


*Fig.3: A THX home theatre setup at Caringbah HiFi. The speakers at the front are a Velodyne subwoofer (left), two Aaron Pro 9's and a Krix centre speaker.*

Changing individual speaker levels from the remote control requires the use of the TV monitor. Alternatively, these settings can be changed at the unit's control panel in conjunction with the front panel display, but either way it's not easy to adjust speaker levels 'on the fly'. However, once set, these levels usually don't need to be changed.

The large number of connections to the rear panel could be reduced with the addition of multi-way connectors. Also, unless you can swing the unit so the back is facing you, identifying connections is quite difficult.

When standing close to the unit, I could hear a 100Hz hum, possibly due by a transformer. I suspect this problem to be unique to the review unit, as others I've heard are completely silent. I could hear no hum from any of the speakers.

## Summary

Space limitations have prevented me describing more features of this remarkable A/V unit. For example, it can operate two independent five-speaker surround sound speaker systems. The parameters of both speaker systems can be set independently, to suit different room and speaker characteristics.

Or, when combined with a separate power amplifier, the system can drive two independent sets of stereo speakers, each with a different sound source. With an optional remote transmitting head (about $100), the speaker system in a different room to the Onkyo can be controlled via the remote control.

The unit comes with two remote controls, a universal type that can be programmed to operate other equipment, and a smaller 'no- frills' version.

I found the Onkyo very easy to drive, despite the large array of available adjustments. The on-screen interface makes all adjustments easy to do, and if you go wrong, it's easy to revert to the presets.

In conclusion, I believe that the Onkyo TX-SV919THX is one of the most exciting and versatile pieces of audio equipment on the market today. Although expensive, it packs a lot of punch into the one package.

And what an investment in family entertainment: superb cinema sound to keep the kids (and adults) off the streets. For music lovers, you can open up a whole new dimension and revisit your CD collection by hearing it through one of the various sound modes. Because of the expansion socket, the unit won't date as different surround decoders are developed.

But I suppose the bottom line is, would I buy one? In a word yes, and in fact I have. That's how impressed I was!

The RRP of the Onkyo TX-SV919THX is $3995. The review unit was supplied by Caringbah HiFi (381 Port Hacking Road, Caringbah 2229, phone (02) 540 1900), who specialise in home theatre as well as hifi products. My sincere thanks to the staff at Caringbah HiFi for their patience and considerable help in preparing this review. ❖

## Video & Audio: The Challis Report

# CSIRO'S A4 VLSI DIGITAL AUDIO PROCESSOR

For this month's report, Louis Challis had the opportunity to both measure and listen to the impact of the revolutionary new 'A4' digital audio processor chip, developed by the CSIRO Division of Radiophysics. In the tests, the A4 was used to 'linearise' the amplitude and phase response of Louis' B&W 801M loudspeakers (already excellent performers), and he describes the end result as 'uncanny'!

Among the multitude of new and exciting products at the 1993 US Consumer Electronic Show at Las Vegas, the Snell Cyberacoustic System undoubtedly created the greatest interest amongst the professional press, and most certainly the hi-fi equipment reviewers. Although I wasn't fortunate enough to hear it work as intended, I was very impressed by the Snell's design philosophy.

What Snell were attempting to do was market a loudspeaker system with associated DSP processor, and for which the DSP algorithm would be individually tailored to suit your specific living room. The concept sounded right; the problem was that Snell had not yet solved all the problems.

Following my return to Sydney, I described the Snell system and the other goodies on display at the 1993 CES (see *EA* for April 1993). I subsequently received a phone call from an engineer whom I know at the CSIRO's Division of Radiophysics. As it transpired, the CSIRO was particularly interested in what I had reported. They enquired whether I had any further information or knowledge as to what Snell and the other major American loudspeaker manufacturers might be attempting to achieve, at that time.

During the course of my telephone conversation, I was intrigued to learn that the CSIRO had recently developed a low cost VLSI chip. That chip was specifically designed to suit the needs of the audio consumer market, was claimed to be low cost, and had been designated as the 'A4'.

As our discussions progressed, I learnt that AWA Microelectronics were currently holding discussions with the CSIRO with view to their licensing the 'A4' technology.

I inquired what would be the likely price of these VLSI chips, and was advised that chips of this type usually cost several hundred dollars in small quantities, with the price decreasing as the volume increases. To underpin that position, I was advised that AWA Microelectronics would be glad to discuss future prices with prospective customers.

I was advised that the 'A4' had the processing power and potential to provide revolutionary results, and especially when compared with any other type of audio or digital sound processing (DSP) chip which were currently available. More significantly, unlike a conventional DSP chip, it could process acoustical data in a myriad of different ways.

Whilst I was interested in what I heard, it would be more than a year before I had my first demonstration of the 'A4' system. That demonstration was organised recently by the Audio Group of the IREE. Having been a member of the audience at that meeting, I was convinced that CSIRO had indeed produced a revolutionary VLSI audio processing chip, and that its power and potential was even greater than I had previously suspected.

### How it came about

Before describing the 'A4' chip and what its real capabilities are, it won't hurt to discover how and why the CSIRO Division of Radiophysics embarked on the development of such a seemingly strange and yet exciting product.

As it happens, the CSIRO Division of Radiophysics has been interested in Fast Fourier Transforms (FFTs), primarily because of their long-standing involvement in the field of radio astronomy. Some years ago Dr Craig Mudge, following his return from a stint at Digital Equipment Corporation (DEC) in the USA, organised a series of courses in Australia on the design of VLSI (very large scale integration) circuits. He felt the need to educate as many Australians as he possibly could, and thereafter devoted his considerable talents in the design and development of a 'multi-project chip' (MPC), the underlying concept of which was that it contains a large number of different projects on the one chip. Only some of those projects were ultimately inter-connected (or wired) up to the output terminals, in order to meet specific circuit requirements.

Dr Mudge's efforts ultimately provided a number of different people in CSIRO, as well as at various universities, with the pre-requisite VLSI design skills. That in turn ultimately led to the creation of Austek Micro Systems, a company which drew many of its staff from the CSIRO.

In the early 1980's CSIRO researcher Jon Ables attended one of Dr Mudge's VLSI design courses. He immediately saw the potential of using VLSI techniques to produce a correlator chip. The CSIRO subsequently designed such a chip, producing 5000 for use in the Australian Radio Telescope at Narrabri. These correlator chips provided the very heart of the radio telescope's output correlator circuit, and without them it would simply not have achieved its ultimate power and potential.

Soon afterwards Dr John O'Sullivan, who had spent many

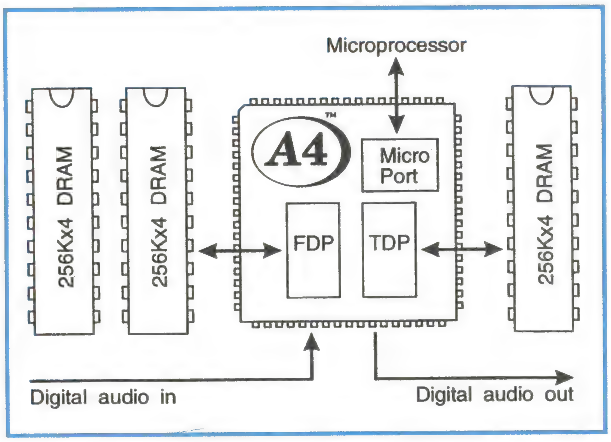
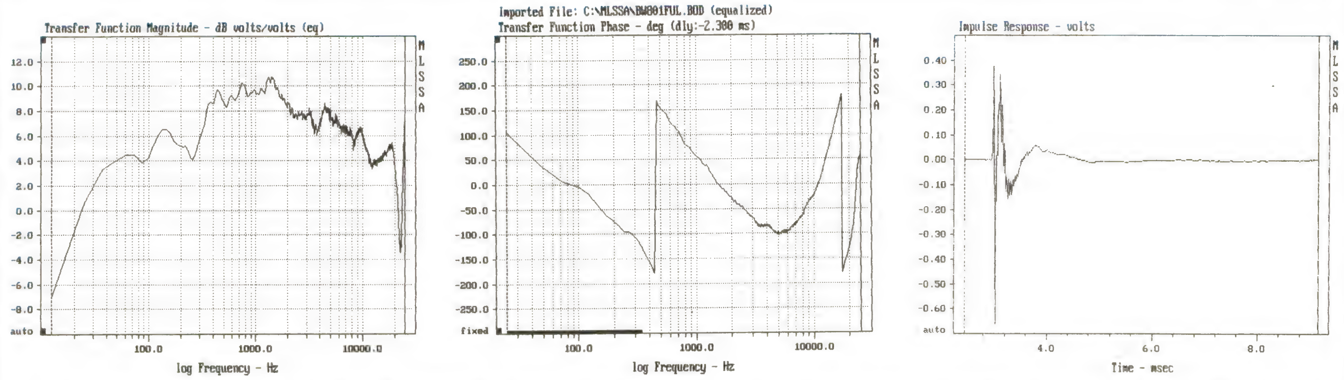
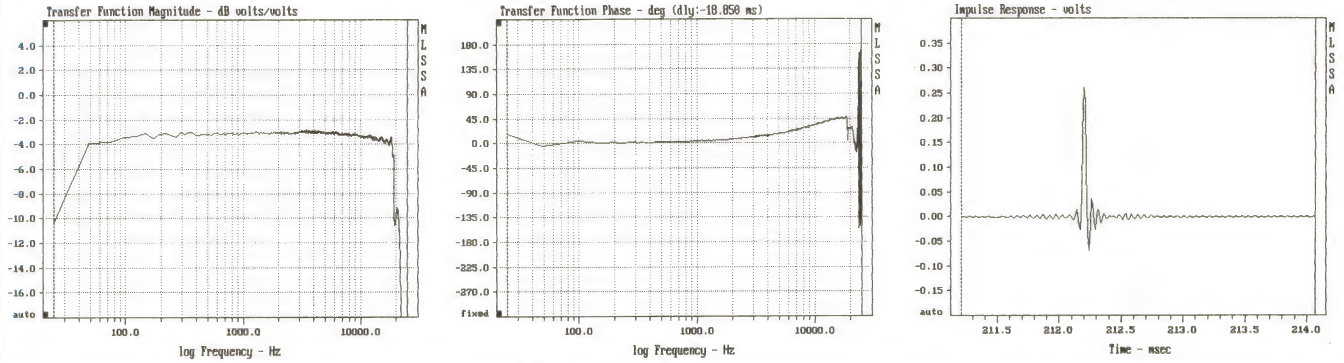


***Fig.1: Unlike many existing DSP chips, the CSIRO's A4 processor needs only three DRAM chips and a 10MHz clock, for a basic implementation.***



***The three plots above show the frequency response, phase response, and impulse response of Louis Challis' B&W801 monitor loudspeaker, in its normal uncompensated state. The curves below show what was achieved using the CSIRO's A4 processor chip, for comparison. The effects are quite dramatic, as you can see!***



years in Holland working on Dutch radio telescope projects, returned to Australia and founded a signal processing group within the Division of Radiophysics. He also completed the VLSI course, but his perception of where such circuits should be used was again different to that of his predecessors.

Dr O'Sullivan immediately recognised that a VLSI chip could be used as a super FFT (fast Fourier transform) processing chip, and that such a chip would ultimately replace the multiple racks full of equipment which were being used for that purpose, at that time. The problem that he faced (and which ultimately all of us face), was that without the necessary resources, (i.e., the money), the task of producing such a VLSI chip was inconceivable.

In 1988, Dr O'Sullivan and his associates received funding from the Australian government through the Industrial Research and Development Board, to extend the work that had already been initiated by the CSIRO. What he and Austek Microsystems wanted to do was to develop a commercially attractive FFT processor using 1.5-micron CMOS technology. It may be history now, but the government provided all the necessary resources, so that the A41102 project went ahead.

More significantly, the A41102 chip is now available through AWA Microelectronics so that anybody can purchase it.

## The A41102 chip

The 'A41102' chip implements a hardwired continuous convolution algorithm on a silicon chip, with the capability of dynamically updating the filter parameters whilst the processing is actually taking place. It incorporates two completely independent 2048- tap FIR (finite impulse response) filters. This in turn allows the A41102 to provide full coverage of the audio frequency spectrum, using its 24-bit and 32-bit internal arithmetic precision.

The A41102 chip is impressive if for no other reason because it computes FFTs at extremely high speeds. It operates as a 'pipeline processor', which outputs 2.5 million samples per second. These samples may be at variable selectable lengths of 16, 20 or even 24 bits, with a clock rate of 40MHz.

The A41102 chip is able to perform 'complex to complex' transforms, with both the normal 'real' plus the 'imaginary' components. It is also capable of performing 'forward' and 'inverse' transforms, with what would be best described as 'naturally ordered' data input, as well as providing 'bit- reversed' data output. Alternatively, the A41102 can accept 'bit- reversed' data input, and produce 'naturally ordered' data output, if such is required.

The A41102 chip also incorporates an 'uncommitted multiplier', which may in turn be used for multiplying the 'input' data stream by any other data stream that you may wish to apply, in order to provide a modified/processed output.

Apparently most people wishing to perform this type of processing currently use a DSP chip, with associated special software, to achieve similar ends. There have been very few dedicated FFT chips produced in the world, because of their complexity — quite apart from the limited demand for such hardware.

Amongst the many other advantages that the A41102 chip offers is its ability to perform various length transforms with powers ranging from two all the way up to 256. More significantly, if two A41102 VSLI chips are appropriately connected in series, then it becomes possible to provide a 64K-point transform, which I perceive is almost mind boggling. Conversely, if four A41102 chips are placed in parallel, the system is able to provide a throughput rate of 10M samples per second, which is also very impressive.

In 1988 the Australian government provided CSIRO with funding to further develop their FFT technology and thereby develop other (and much wider) uses for that technology.

In 1989, a senior researcher in the group suggested the possibility of producing a relatively inexpensive chip, which would be based on the FFT technology which had already been developed for the A41102 VSLI chip. His concept was that the new chip would ultimately tap into the burgeoning consumer audio market. His vision for a new chip ultimately became the 'A4'. Before proceeding with its development, CSIRO decided to arrange for market research to be conducted in the United Kingdom and the USA, to assess what the future reaction might be to such a development.

Their agents contacted many of the key players in the audio industry, all of whom were willing to discuss the merits of the project. Those contacts soon led them to the conclusion that there was an extremely large market in the mobile (car) audio field. That market would ultimately draw on the powers of the A41102 processor to provide digital compensation of loudspeakers and thereby produce hi-fi sound inside cars.

Their contacts advised them that if the cost was right, and the implementation was not unduly complex, then the market would most probably accept this development with 'open arms'.

Their research lead them to the conclusion that the new 'A4' system should *not* require the substantial 'glue logic' that commonly characterises other DSP systems. In fact, their final design only requires that the 'A4' chip be supported by three inexpensive 256K x 4-bit DRAMS and a 10MHz clock (or crystal) — see Fig.1.

Having decided to proceed with the development of the 'A4' chip, one obvious issue that had to be resolved was how they would market the chip. The CSIRO development team was very conscious of the need to have the chip accepted by the prospective users.

It was apparent to them that existing DSP processors were not particularly well understood. In such circumstances, it was apparent that it would be an even more complex task for people to understand, let alone accept the concept of an FFT chip.

Their first step was to configure the 'A4' as a digital filter, rather than as a straight FFT processor. Whether the 'A4' is used as a digital filter, or as an FFT processor, they took the view that the user doesn't really need to know 'how' or 'why'.

## Development system

Having decided to follow the path in which the fundamental principles would be (i) low cost, and (ii) ease of implementation, they then decided to take the third and somewhat more critical step. This involved the production of a fully fledged development system, which would be supported by all the necessary software, hardware and the related documentation.

The complete setup was then appropriately packaged, as would be any other commercial item of similar type with two individual processors in a fancy box.

That box incorporated all the necessary cabling and 'bits and pieces' through which the intending development engineer could correctly implement one, or both of the following paths:

1. A frequency-domain processor (FDP)
2. A time-domain processor (TDP)

It is the FDP function which both elevates and delineates the 'A4' from any other DSP type chip that may have already been developed. Thus by way of example, the 'A4' chip can function as a 2x1024 channel graphic amplitude equaliser (with a linear frequency scale). Because the FFT processor operates with a 32-bit architecture, even when allowing for the rounding-off errors, its useable dynamic range still exceeds 100dB. This is the result of providing a 22-bit dynamic range at the FDP output. As a consequence, the dynamic range provided is considerably better than would be required by most consumer-related sound processing functions.

At the same time as providing the amplitude function, the 'A4' functions as a 2x1024 channel graphic phase equaliser, with both the amplitude, as well as the phase functions being simultaneously executed.

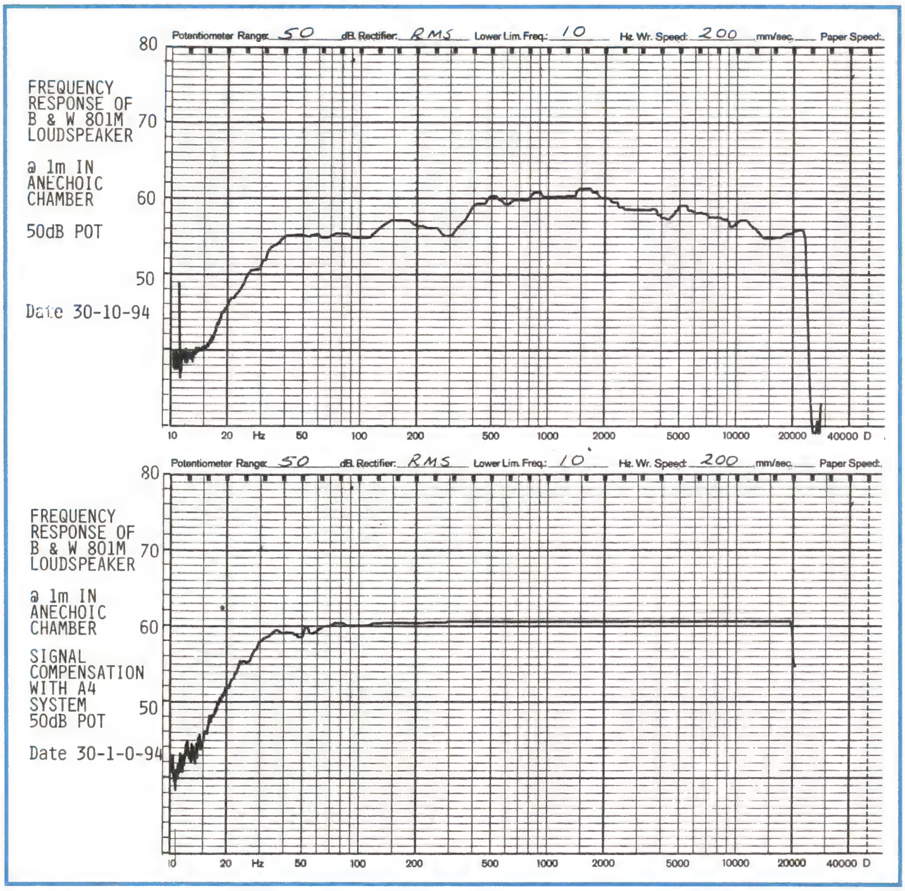
The left channel is completely independent from the right channel, and the user is thus able to specify the centre frequencies on the basis of the sampling frequency divided by 2048. In the most typical format, the chip provides a 22.4Hz frequency spacing all the way from 22.4Hz up to 22.05kHz.

When used as a graphic equaliser, or more pointedly as a graphic filter, it is possible to insert a 60dB notch which is only 22.4Hz wide, at any point within the frequency range. The incorporation of such an unusual filter notch does not inhibit the retention of a linear phase response, right across the full frequency range.

## In practice...

Whilst the 'A4' chip offers a range of exciting solutions to industrial, defence and/or purely scientific applications, its most obvious use will be as a special audio processor, providing dedicated applications for which solutions have not previously been available.

I was able to arrange for an 'A4D2 Development System' to be brought to my laboratory, supplemented and supported by the experienced engineers required to determine and set its critical characteristics. I had already heard its efficacy when used in conjunction with a very cheap loudspeaker system. That demonstration confirmed that the 'A4' system is capable of achieving impressive results. But having confirmed that a 'relatively poor loudspeaker system' can be transformed into a 'reasonably good



***Two more curves taken by Louis Challis, in this case using his Bruel & Kjaer measurement equipment. The top curve shows the B&W801 monitor speaker au naturelle, while the lower curve shows the impact of the A4 processor.***

loudspeaker system', the question that remained was — what can the 'A4' system do to a *good* loudspeaker?

With some gentle prodding from the CSIRO team, I brought one of my B&W 801M monitor speakers into the laboratory so that we could evaluate what order of magnitude of improvement can be achieved by the 'A4' system, when a very good loudspeaker is used as a starting point.

The initial analysis was performed using a MLSSA based computer controlled audio analysis system. The microphones, preamplifiers and measuring amplifiers at the input of the MLSSA system were precalibrated Bruel & Kjaer equipment. Those measurements were supplemented by a conventional Bruel & Kjaer analysis system, whose results are presented below.

As you will note from Fig.2, the frequency response of the B&W 801M loudspeaker, when measured at 1m from the face of the speaker under anechoic conditions is reasonably smooth, but far from flat. In like manner, the phase response measured under the same conditions is also reasonably smooth, but far from flat at that position (see Fig.3). The impulse response measured under anechoic conditions is reasonably good, but again far from perfect (Fig.4).

After the CSIRO engineers had measured each of these parameters, the 'A4' system was programmed to produce a compensated flat frequency response, and similarly compensated flat phase response (see Figs. 5 - 7). Under these conditions, the impulse response is transformed and displays an almost perfect textbook response. The ripples are evident, but they are by no means unexpected, or unacceptable.

## The audible result

After the initial series of compensated measurements had been performed and the results recorded, I took the opportunity to listen to the difference between the uncompensated 801M loudspeaker and when it was compensated.

For the first subjective test, I used a pink-noise generator to provide a reference signal. With that test signal we arranged the hardware so that we could inter-compare the subjective audible differences between the unmodified B&W 801M loudspeaker with those provided by the same speaker with A4 compensation. This comparison involved a sequential 'A-B, A-B, A-B...' listening sequence in the middle of our anechoic chamber. The 'pink noise' test provides an extremely accurate means of inter-comparing overall frequency response, and most particularly, a comparative frequency response.

In the 'uncompensated' mode, the B&W 801M sounded very smooth, and almost devoid of audible colouration. But with the A4 compensation activated, there was an immediate enhancement in the sound quality, and the change in the spectral balance could best be described as being an almost 'uncanny'.

The subjective impression was that the pink noise signal was the smoothest I have ever heard, and that was particularly impressive. I was unable to detect any trace of tonality in that 'compensated' signal.

Having thus confirmed the merits of the A4 system with a pink noise source signal, I progressed into the equally demanding pre-recorded musical assessment.

For this test, I used a demonstration disc entitled 'The Great Fantasy Adventure Album' (Telarc CD-80342) featuring Erich Kunzel and the Cincinnati Pops Orchestra. Now as it happens, this album is unusual. Although it contains 17 well (but conventionally) recorded theme music tracks from recent films, these are arbitrarily interspersed with five high-level tracks, which are best described as sound effects. These incorporate unexpected infra-sonic and related unusually wide dynamic high frequency signal components. The rear of the disc, as well as the internal booklet in the lid of the box, caution the user on the need to avoid playback levels which could result in damage to their equipment.

Now this disc is simply not designed for the 'faint hearted'. As I soon discovered, the sound effects on the disc provides some dramatic and (at three locations) positively daunting demonstration software. Using this material you can display the attributes (or alternatively the deficiencies) of a sound system, and most particularly, how well or how poorly the loudspeakers perform.

At the start of my assessment, I was initially perplexed by dramatic aural differences in the quality of sound of my 801M monitor loudspeaker in that particular environment, when compared with the performance it displays in its normal listening environment.

Now in case you're not familiar with anechoic chambers, they modify the normal bass response, and in particular, the low frequency components emitted by the speaker at frequencies well under 200Hz. This modified frequency emission response comes as a result of the absence of the normal floor, wall and ceiling reflections.

In the normal environment, these reflections provide a critical component which controls the level of low frequency sound you hear at your listening position. The mid-range and high frequency drivers do not rely to the same extent on such reflections, and consequently their sound emission in the anechoic chamber was generally comparable with that provided by a normal listening room environment.

I was acutely aware of the 'uncompensated' sound quality in that environment, which was both unnatural as well as being peculiar.

With the 'A4' compensation switched on, there was an immediate and obvious difference in the character of that sound. The most notable difference was a change, which I soon realised was an improvement in the loudspeaker's low frequency response.

The differences elsewhere in the frequency spectrum were harder to identify, but were nonetheless detectable. A comparison of the objective test results seemed to equate to what I could hear, but my lack of familiarity with speakers providing that type of frequency response inhibited a truly objective/subjective assessment. What improvements I could hear, were modest, although finite.

## In conclusion

My evaluation of CSIRO's A4 Development System has examined its capabilities from a narrow perspective. That perspective has examined its potential to linearise the amplitude and phase response of a loudspeaker system under one specific set of conditions.

Our examination of that situation has confirmed very positively that the A4 system achieves almost all that could possibly be asked from it, in terms of its ability to correct (enhance) both the frequency and phase characteristics at a pre-determined (fixed) listening point — as for example would be typified by an automotive sound system.

Given the amount of money being spent in the USA, Europe and Japan on car audio, I see a bright and exciting future for the A4 system when it is adopted by the car audio firms, as it will ultimately be.

There are of course even more exciting and widespread uses for the A4 system, and they will involve the use of loudspeakers which initially must be described as being inferior, in terms of both their frequency and phase responses.

Whilst the B&W 801 series of loudspeakers have been meticulously designed to achieve close to optimum phase response, with closely spaced tweeter and mid-range driver, most other systems have not been so carefully designed. The A4 system offers those systems a cost-effective means of closing the gap between the 'haves' and 'have nots' of the speaker world, without necessarily having to spend $5000 more to understand or be able to hear the magnitude of the difference.

For our next review, we are going to examine just how effective the CSIRO's A4 system can be when applied by an Australian manufacturer to a loudspeaker system which would not normally be compared with a B&W 801 monitor speaker system. It should be very interesting. ❖

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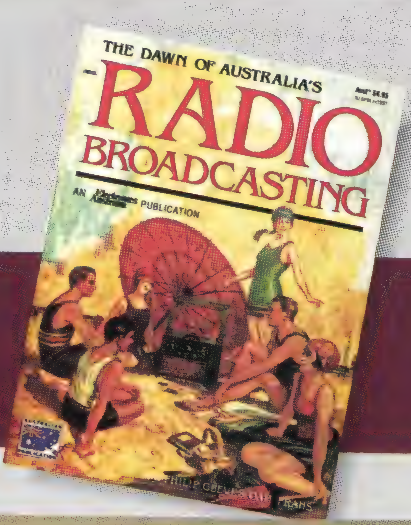
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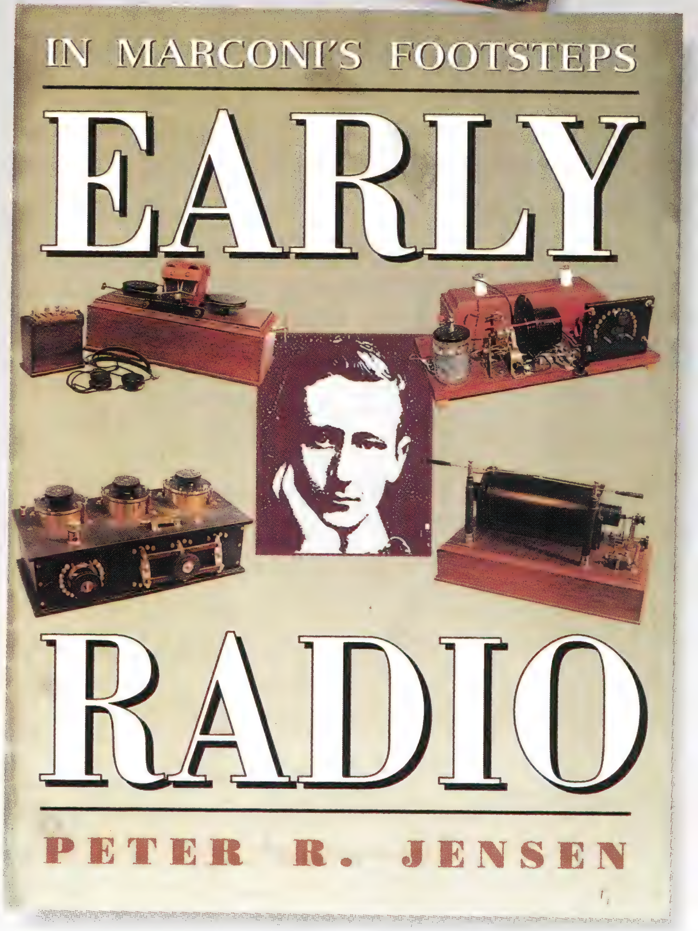
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EARLY RADIO

PETER R. JENSEN

Marconi played a key role in developing radio as a practical medium of communications, and although there have been a number of books written about him, in this new one Peter Jensen has taken a rather different approach. The basic chronological account of Marconi's life and achievements is intertwined with a separate but linked narrative of Peter's own recent visits to key sites, such as the Villa Grifone near Bologna, Salisbury Downs, Dover, Poldhu and Clifden.

For the more technical reader, there's also a 'second half' of the book giving an expanded description of many items of Marconi's equipment and construction details for making replicas.

It all makes much more interesting reading than most other books dealing with this kind of subject.

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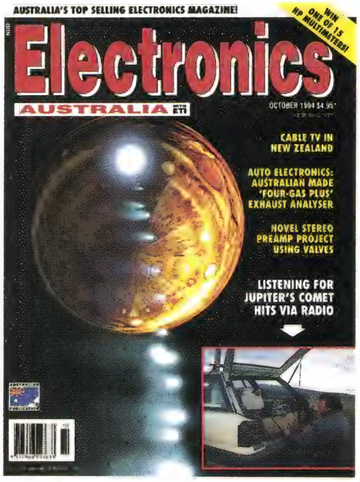
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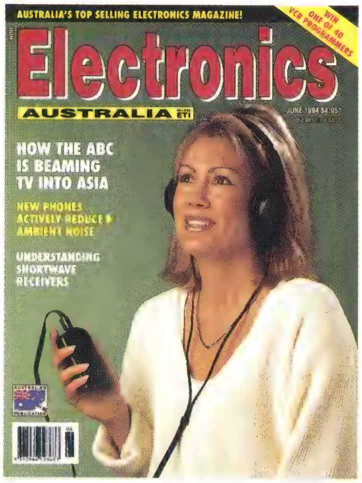
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# RECEIVER IMPROVERS: HOW GOOD *ARE* THEY?

Following the publication of Tom Moffat's recent series of articles on shortwave receivers, quite a few readers asked if we could get Tom to write about the add-on DSP 'reception improver' units which have recently become available. Tom was happy to oblige — in fact, in this article he not only discusses what they do, but also reviews two of them...

### by TOM MOFFAT

Digital Signal Processing (DSP) is a fairly new technique, which can be used to enhance the performance of a radio receiver after the radio has already done the best it can recovering a signal. For receivers of modest design, DSP can make up for things left out to save money — such as top-quality IF filters. And DSP offers some rather way-out methods of signal enhancement, to make even top range radios do previously unheard-of things.

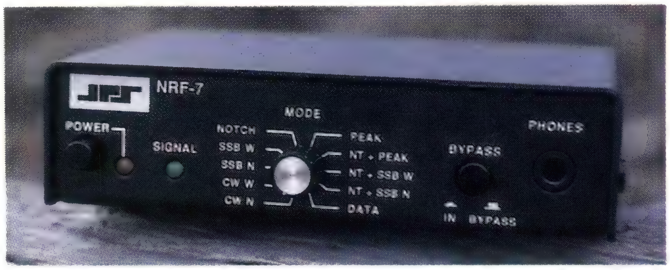
DSP is simple to implement on existing radios. All you have to do is plug the DSP unit into the radio's audio output; no internal modifications are required at all.

In this article we will look at two 'black box' DSP add-ons from JPS Communications in the USA. Each unit simply plugs into the receiver's speaker output, and you plug an external speaker or headphones into the DSP box. That's it; no receiver modifications are required at all. A 12 volt DC plugpack completes the installation.

## The NRF-7 unit

The NRF-7 unit sports a big mode switch of the type that might be found on a top-of-the-line communications receiver. It offers wide and narrow filters for single sideband (SSB), Morse code (CW), or data such as radioteletype (RTTY). These work in fairly conventional ways, taking the place of similar filters which might not be included in a modest receiver. The NRF-7 also features a notch filter, but there's no control knob for it. Reason: it's automatic! If you tune to a signal with a heterodyne on it, selecting NOTCH on the mode switch makes the whistle disappear.

I tested the notch filter by tuning the radio in SSB mode to a constant unmodulated carrier. When I engaged the notch filter the carrier disappeared (and I mean it *disappeared* — it wasn't just reduced). I gave the tuning a twist, and the pitch of the heterodyne changed and it popped up again briefly. But the automatic notch filter quickly found it again, and squashed it flat. This was a most impressive performance...



***JPS Communications' NRF-7 outboard DSP unit provides a range of audio filters, including a notch filter which automatically tracks heterodyne whistles.***

Another NRF-7 feature is its PEAK mode. On first glance one would expect it to be the opposite of the notch filter, lifting a steady tone from its noisy surroundings instead of suppressing it. This is true to a certain extent, and it makes for nice easy listening of a Morse code (CW) signal. But the PEAK function also works on voice, even though voice bandwidth is certainly not a single-tone 'peak' — because the PEAK filter expands and contracts to fit the signal.

The PEAK function will be explained more fully under the NIR-10 unit below; suffice it to say that the NRF-7's version works very well, although not as spectacularly as the one in the (more expensive) NIR-10. It is also possible to bypass the NRF-7 unit entirely, using a front-panel button. In this case, what goes in comes out, even with the power off. So you can leave the unit sitting near the receiver, permanently connected.

I gave the NRF-7 a good run on a top-range Icom R-71A communications receiver, as well as the general coverage receiver part of an Icom IC-735 amateur transceiver. Both these radios are designed with excellent single-sideband filters.

On the R-71 receiver you can bypass the SSB filter while still receiving SSB, so I removed it and then tried the receiver with both the wide and narrow SSB filters in the NRF-7. These filters restored the radio's performance on SSB to what would be expected with a good-class radio. They certainly weren't any *better* than the internal filter; in fact, there was very little difference between the filters in the radio and the NRF-7.

As for CW, both of my receivers are equipped with optional high performance CW filters. However these narrow filters are quite expensive and specialised, so most receivers would not have them. Instead, in CW mode you usually hear a collection of Morse stations all going at once, both on the ham and marine bands.

The narrow CW filter in the NRF-7 was able to pick these out one by one, just like the optional filters in the receivers. This was a surprisingly good result, and the sound was very smooth. The audio tone delivered by the NRF-7's CW filters can be set by an internal jumper to 400, 800, or 1000Hz.

I feel that the prime purpose of the NRF-7 unit is to provide some of the filtering functions missing from a less salubrious receiver, and it really shined when connected to a Sony ICF-SW7600 portable.

This little book-sized radio covers all the shortwave bands, along with AM and FM broadcast. It doesn't have proper SSB or CW modes, only a BFO (beat frequency oscillator) to allow rough-and-ready demodulation of them.

As for SSB or CW filters, I don't think there are any. If you tune across a crowded amateur band you will hear many SSB stations all going at once, some higher and some lower than your tuned frequency. As for CW, more of the same, much more... (A plot of the Sony's response curve is shown in Fig.6 on page 23 of Electronics Australia for June 1994.)

With the NRF-7 hooked to the Sony, SSB and CW stations could be picked out one at a time, just like with the R-71A. Of course *tuning* them was still hard — the radio only switches to 5kHz spots and you must then use a tiny thumb-wheel control to fine-tune between them. Still, once a station is tuned in, you could turn your back and it would be hard to tell whether you were listening to the big R-71A or the little Sony.

## The NIR-10

The NIR-10 doesn't look quite as impressive as the NRF-7 unit, but that's because it doesn't have that big mode switch showing everything it can do. Controls are limited to three toggle switches and two control knobs. But within the NIR-10 are some features that can only be described as *startling*.

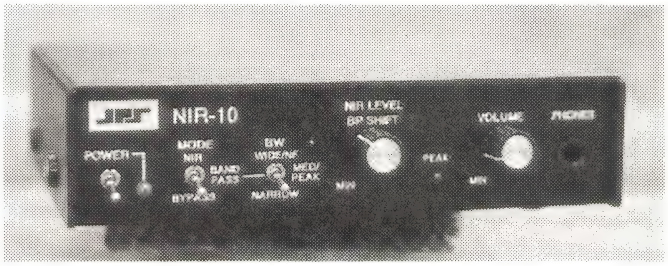
The NIR-10 includes a bandpass filter with a selection of wide, medium, or narrow bandwidth. The function is similar to the SSB and CW filters in the NRF-7, although with the NIR-10 you can adjust the centre frequency to your taste with a continuously variable front panel control.

Both the NIR-10 and NRF-7 filters are produced digitally, so they can be designed with very steep selectivity curves. And even with the narrowest bandwidths there is no 'ringing' as would be the case with filters constructed of analog circuits. Instead the digital filters produce a 'raspy' sound as the bandwidth of the signal approaches the limit of the filter.

The WIDE bandwidth selection in the NIR-10 is just right for SSB, and also useful for pruning interference from AM signals. Its rated bandwidth is 1800Hz, but remember that its centre frequency can be slid up and down with the front panel control. So you could set it with a low cutoff of 300Hz, with the high limit falling at 2100Hz.

MEDIUM bandwidth is specified at 600Hz, making it useful for something like RTTY signals with a 440Hz shift. See the discussion under 'Data modes' below. As for the NARROW filter, it's specified at 250Hz bandwidth but in practice it seemed much narrower. A single clear Morse signal just wouldn't fit through it without causing some raspy noises. I found the medium filter much nicer for CW work; it is similar in bandwidth to the optional CW filter fitted to the R-71A, and it sounds just as smooth. Keep in mind that you can choose your centre frequency at any time, and if you tire of listening to CW signals at a high pitch you can wind them all lower for a while. Changes like this reduce fatigue.

Enough of mundane filter matters. Let us now examine some of the way-out modes of the NIR-10, that would have been little more than twinkles in a designer's eye a few years ago.



***Although it may not look quite as impressive as the NRF-7, the NIR-10 provides even more facilities, including the special NIR function — which Tom says is 'sheer magic'.***

## The NIR feature

Heterodynes, white noise, ignition noise, RTTY interference, power line noise — Biff! Zap! Pow! All of these are blown to oblivion by the NIR function. Well, mostly, anyhow. As a first experiment with this gadget I searched for the lousiest signal imaginable, and found it on the low frequency band — an airport beacon at Launceston on 242kHz, received in the middle of the day in Hobart, in a noisy urban environment 200km or so distant.

This 'non-directional beacon' (NDB) emits the usual slow Morse code identifier, but as well it carries a recorded voice transmission of Launceston airport's ATIS (automatic terminal information service). I know from past experience that you can barely tell this station is there during the day; you can usually pick out the CW identifier, but as for the voice, forget it. If you're lucky you can detect a mumble, but that's all.

So I tuned in this NDB, then hit the NIR switch on the black box and fiddled with the 'NIR LEVEL' control. Suddenly the radio began speaking: 'LAUNCESTON TERMINAL INFORMATION BRAVO... RUNWAY 32 WEST... WIND 330 DEGREES 10 TO 15 KNOTS... QNH 1008... TEMPERATURE 12...' Hey, is this magic, or is this magic?

How does this happen? Well, that's a little unclear because the instruction book doesn't tell you much, but certain actions are likely. First, it is important to know that everything that comes out of the NIR-10 is delayed by about 1/8 second from what goes in. So all audio spends an eighth of a second in there, being analysed by a special 'digital speech processor' integrated circuit. From the listener's point of view, what you are getting is a product of what happened an instant ago, what's happening now, and what will happen an eighth of a second into the future.

The speech processor 'knows' that human speech varies in certain ways with a certain rhythm and cadence. Hence the need for a time span to measure it. It also 'knows' that speech contains certain frequencies related to each other in certain ways. Anything that does not meet the speed or frequency criteria is declared rubbish and sent off to noise heaven. Components that are considered valid speech are reassembled in the chip and presented to the listener.

All this requires furious activity within the special speech processor chip. It looks like a big microprocessor, and resides next door to a clock oscillator that's clicking it over at 40MHz. There are also 14-bit A-D and D-A converters which send the speech data in and out of the chip as serial streams, a bit at a time. The result is that you're not hearing the guy at the transmitter talking through your radio, you're hearing the digital speech processor chip speaking his words. Scary, isn't it?

There are limits to this, of course. If the signal is just too far buried in the noise (signal to noise ratio worse than 0dB or so) the system simply gives up. The above-mentioned NIR LEVEL control lets you vary the amount of processing, to try to 'nurse' out an audio signal with the best possible sound. If you take this too far the noise takes on an interesting 'gurgly' effect... it's very electronic sounding, and very weird.

So the NIR thingo takes a little getting used to, but it's well worth while. Later on I had another go, on a signal in the 3MHz international broadcast band, again during the day. Here you sometimes find nice warm signals from the Pacific islands, but seldom during the daytime. I attacked this signal with the NIR as before, fiddling with the level control, and soon it started speaking — Chinese! So I still couldn't understand it.

Unfortunately this version of the digital speech processor can't decode Chinese into English. (Yet!) Still, that was remarkable reception over such a distance, on such a low frequency, during daytime. It's interesting to note that the NIR seems to work considerably better on steady daytime signals than it does on quickly fading signals coming in on 'skip' during the night.

Because the digital speech processor is designed to process ONLY speech, it makes quite a mess of music. It obviously sees music as a collection of noises and heterodynes, and it makes every attempt to get rid of them while at the same time trying to preserve the signal, which is music. So it seems to get all tangled up in itself, and the result is some very strange sounds indeed.

## The PEAK function

This is promoted as kind of an 'also-ran' in the JPS communications literature, but it seems to me to be more important and useful than even the NIR. 'Peak' isn't the right name, because the PEAK function is really a rubber filter. To explain...

The *EA* 'using receivers' series showed that a traditional filter generally has a fixed bandwidth, tailored to allow the passage of certain types of signals. If the signal is wider than the filter, it hits the sides, causing distortion. If the signal is narrower it fits through all right, but there is room for noise to come through as well. If the signal bandwidth is just right for the filter bandwidth, then everything's rosy.

Most filters have 'concrete walls' like a doorway, and if something doesn't fit through, tough luck. But imagine a filter with its walls made of rubber curtains, which meet at the centre to keep the portal closed. If a wide signal came along it could simply 'push its way through' the doorway, which would then snap closed behind it.

The PEAK function implements the rubber doorway. When a desired signal knocks on the door, the filter dynamically widens just enough to let the signal through.

When the signal has passed through, the rubber door snaps shut again, EVEN BETWEEN WORDS OR SYLLABLES. When the rubber curtains are snapped together the filter effectively has zero bandwidth, so NOTHING gets through. The result is sweet silence during every little pause in speech, with the speech itself unaffected.

I made my first serious test of the PEAK mode listening to a routine New South Wales coastal weather broadcast on the marine channel 2201kHz. And it sounded just like it was coming over a telephone, not a radio circuit at all. During pauses in the speech, and between words and syllables, the radio went totally silent. However, when the announcer rattled some papers, that sound came through fine. Now how did the digital speech processor know that was a legitimate 'sound' from the transmitter, and not noise? The mystery deepens.

Next I tried an aviation channel on 10.051MHz, carrying a weather broadcast from New York radio; time — late afternoon. This was a woman's voice (the digital speech processor is non-sexist) coming from the other side of the world, and the signal was so weak it was not moving the S-meter. But the PEAK function still worked fine. There were occasional little blurts of static getting through, so I hit it with a gentle dose of the NIR as well, and that quieted it down to telephone quality once again.

Later I tuned to the South Pacific aviation channel on 8867kHz and just let the radio run with both PEAK and NIR engaged. This frequency features ground stations at places like Sydney, Auckland, Nadi, Tahiti, and Honolulu, as well as aircraft flying international routes. So signal strength varies from rock-crushing from Sydney, down to barely audible for some of the distant planes.

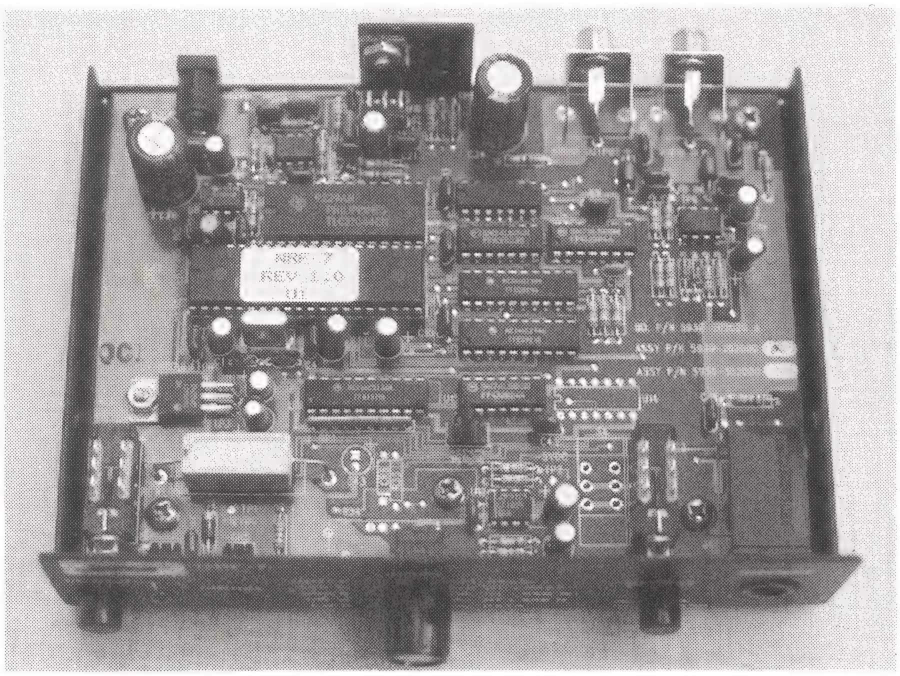
All stations came through fine, with silence between transmissions. One surprise signal came from a technician working on an aircraft radio at Port Moresby. After a perfunctory radio check he asked for what he really wanted, the rugby scores. And the air traffic controller at Sydney gave them to him...

It is normal practice for users of radio channels like these to leave their receivers turned up loud, regardless of the noise, so as not to miss any calls. This can be pretty stressful after a time; try it for yourself. I can see noise killers like the NIR-10 welcomed into marine and aviation stations, once the technology is proven foolproof.

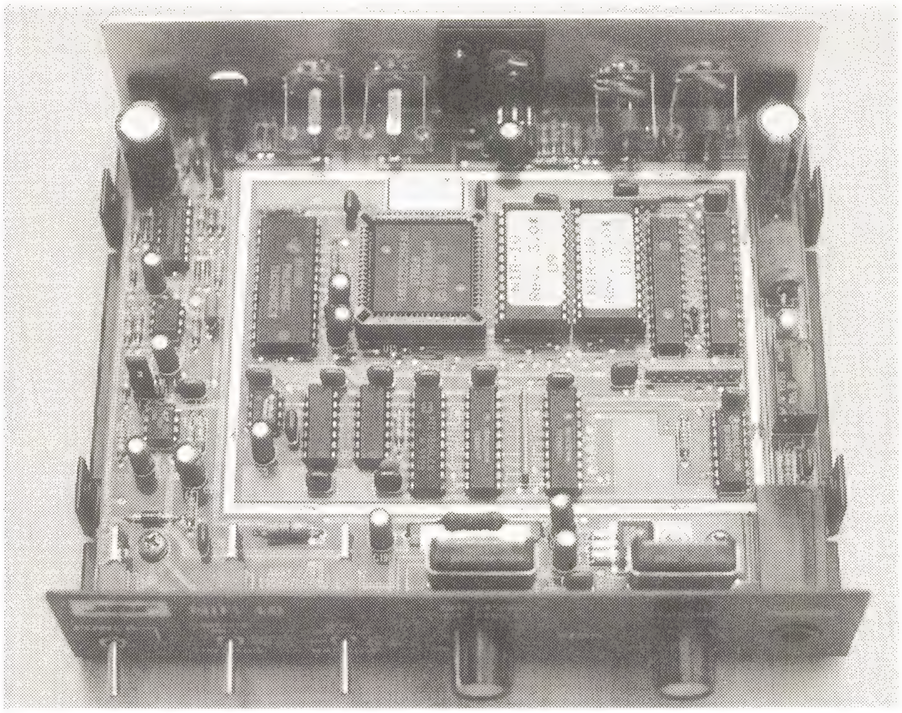
## Data modes

It appears that 'digital speech processing' really MEANS speech. I gave both DSP units a pretty good trial on non-speech modes, with somewhat mixed results. I fed audio from the DSP units to Listening Post II and Listening Post Wesat decoder kits, and then on to a computer for display.

For radioteletype (RTTY) I used the medium width of the tunable bandwidth



***A look inside the NRF-7. As all of the filtering and other audio processing is done digitally, there's no sign of conventional analog filter components...***



***Opening the NIR-10 also reveals an array of digital chips, including in this case, a DSP processor from Texas Instruments. Note the prominent ground track barrier around the central circuitry.***

filter on the NIR-10. With the receiver tuned to a noisy 'press circuit' RTTY station, the filter definitely made reception easier.

For wide shift (850Hz) RTTY and for weather fax, the WIDE filter is the correct choice. When using a receiver like the Icom, the NIR-10's wide filter doesn't offer any improvement on fax and wide-shift RTTY since the radio already has a very good filter of the correct bandwidth. Adding a second filter doesn't achieve anything.

As for automatic computer reception of Morse code, adding the extra filters in the NIR-10 didn't really improve operation, probably because the Listening Post II decoder already uses a very narrow filter of its own in CW mode.

Another experiment was to use DSP in an attempt to clean up some noisy weather satellite signals. These were received as a Russian Meteor satellite was flying over the coast of Antarctica, just before disappearing beyond the horizon. Signals like this are slowly engulfed in white noise as the distance increases, until the noise is all that's left. I used a tape recorder to replay one picture three times using different DSP modes.

First, listening through earphones, I tried the PEAK mode of the NIR-10 unit. This seemed to strip almost all the audible noise from the satellite signal, leaving only the familiar 'honk-honk' sound of the Meteor spacecraft. It sounded highly promising. But when I fed the signal into the decoder, YUK! There were dark and light horizontal bands on the picture, caused by changing audio levels.

And the overall picture appearance became 'muddy'. It appears that the DSP process takes certain liberties with audio output levels which would never be noticed in speech, but are ruinous to an amplitude-modulated video signal.

For the second attempt I used the NIR-10's wide bandpass filter. This was a little better, but the picture still looked muddy and signal fades were evident. Finally I abandoned the DSP units and fed the audio straight into the Wesat decoder. This at last produced a lovely picture of the Antarctic coast, complete with icebergs.

This is not meant as a criticism of the DSP units. I suspect they see satellite signals as the enemy, just like they do with music. Still, it was an interesting experiment to see what would happen.

## Summarising...

These DSP units are very interesting, and very tempting. It is hard to describe in a few words how well these things work; you really have to hear them to believe them. This is the kind of technology we could only dream about a few years ago. Now you can buy it in a black box, and I would suspect it won't be long before some of the classier receivers have DSP chips built in.

The JPS black boxes are very nicely made, and they look like they should last forever, or at least until they get made redundant by some even more startling technology. The NRF-7 in particular looks and feels like you could use it to jack up a truck, and within both units are some of the nicest circuit boards I've seen in a long time. Such lovely work, however, doesn't come cheap. The prices in Australia are $461 for the NRF-7 and $655 for the NIR-10.

I look at things like the DSP units and I think this is the kind of stuff we should be making in Australia. Maybe we can't compete with the world producing televisions and videos, but we could certainly do well in the specialised market stuff. There you're selling brain power rather than mass consumables.

In fact I can't help seeing it in the Tasmanian context — in this island state we are going for the 'clean and green' image, and producing things like gourmet wines and gourmet seafoods. It ain't cheap, but it's good. Maybe we should start doing gourmet electronic goods...

Thanks to ZRV Electronics, the importers of JPS Communications products, for letting us look at these DSP units. They tell me they've got some more goodies in the pipeline as well, so stay tuned!

Further information is available from ZRV at Unit 10, 29 Peel Street, Eltham 3095; phone (03) 439 3389, or fax (03) 439 2483. ❖

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# CALLING ALL SPACECRAFT!

Since the late 1950's, NASA's Deep Space Network or 'DSN' has been providing the communications facilities between Earth and a great many of the spacecraft that have been sent out to explore our solar system. Here's an interesting look at how the DSN developed, how it works, what it has achieved and the role played by Australia's DSN earth station facility at Tidbinbilla, near Canberra.

### by KATE DOOLAN

Whenever most people think of space, they think of flights by humans — especially the Apollo flights to the Moon, and the now almost routine flights of the space shuttles.

However since the beginning of the Space Age in October 1957, the 'quiet achievers' have been the American planetary spacecraft, which have explored all the planets in the solar system except Pluto and have extended our knowledge of our closest neighbours. Soon even Pluto will receive a visit from the Pluto Fast Flyby spacecraft, which will be launched in the next seven years.

To communicate with these planetary explorers, the USA's National Aeronautics and Space Administration (NASA) uses the Deep Space Network (DSN) which is the largest and most sensitive scientific telecommunications network in the world. The main goal of the DSN is to support interplanetary spacecraft, radio and radar astronomy in the exploration of the solar system and the universe.

The DSN also has responsibility for supporting some Earth orbiting spacecraft — primarily ones in 'high' Earth orbit and most recently a selected group in low Earth orbit.

Communications requirements for Earth orbiting spacecraft are very different from deep space flights, so communications for the majority of Earth orbiting is provided by the Tracking and Data Relay Satellite System (TDRSS), which is NASA's second major space communications network (see *EA*, June 1993).

The forerunner of the Deep Space Network was the Microlock system, which was developed by the US Army's Jet Propulsion Laboratory (JPL) to track America's first satellite *Explorer 1*, which was launched on 31 January 1958. The Microlock system was a series of portable 1.5-metre helical antennas located in Nigeria, Singapore and San Diego, California, and these successfully tracked *Explorer 1*.

On 01 October 1958, NASA was established by the United States Congress to consolidate the separate military space programs into the auspices of a civilian space agency. As part of this consolidation, the Jet Propulsion Laboratory was transferred to NASA on 03 December 1958, and soon after was given responsibility for developing ambitious plans for automated lunar and later planetary spaceflights.

Soon after these happenings, the Deep Space Network was established as a separately managed and operated communications facility that would eliminate the need for separate networks for each individual program.

As a major NASA facility, the DSN's main responsibility is to provide each spacecraft mission with a maximum return of scientific data of acceptable quality over the mission lifetime, which could be over 30 years.

Every American space mission is designed to allow continuous radio communications with the spacecraft. Continuous 24-hour-a-day coverage for deep space missions requires several Earth based antenna stations, at locations that will compensate for the Earth's rotation. Because the Earth is rotating at 0.004° per second, all celestial bodies (including planetary spacecraft) appear to rise in the east, travel slowly across the sky and set in the west.

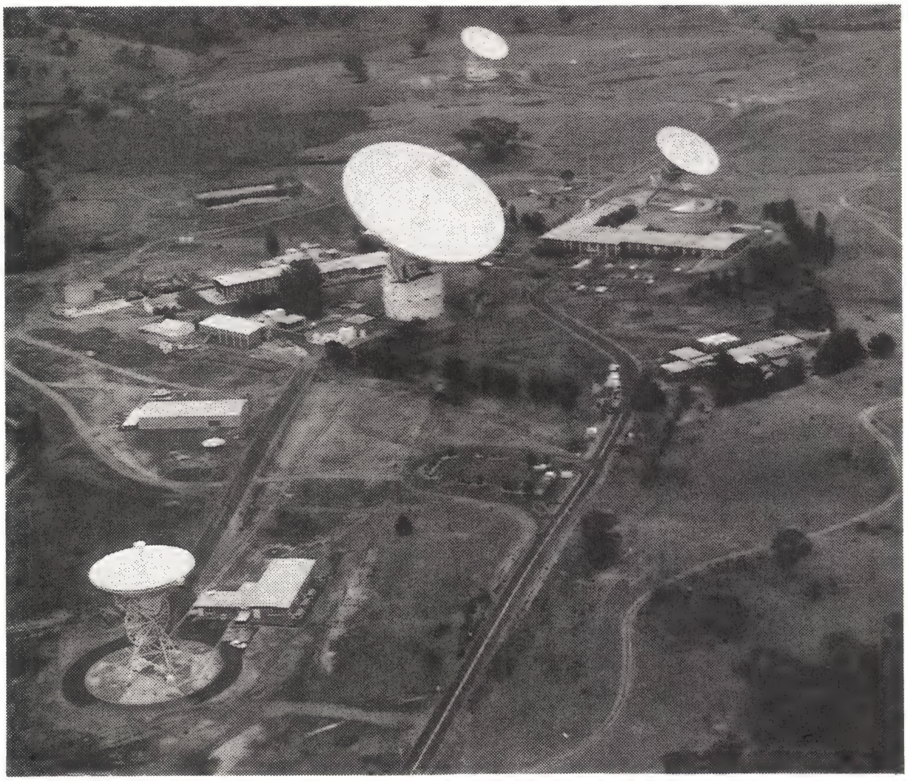
## Three complexes

The Deep Space Network consists of three deep space communication complexes, located on three continents: North America, Europe and Australia. The North American complex is located within the grounds of the US Army's Fort Irwin National Training Centre, at Goldstone in the Mojave Desert in California.

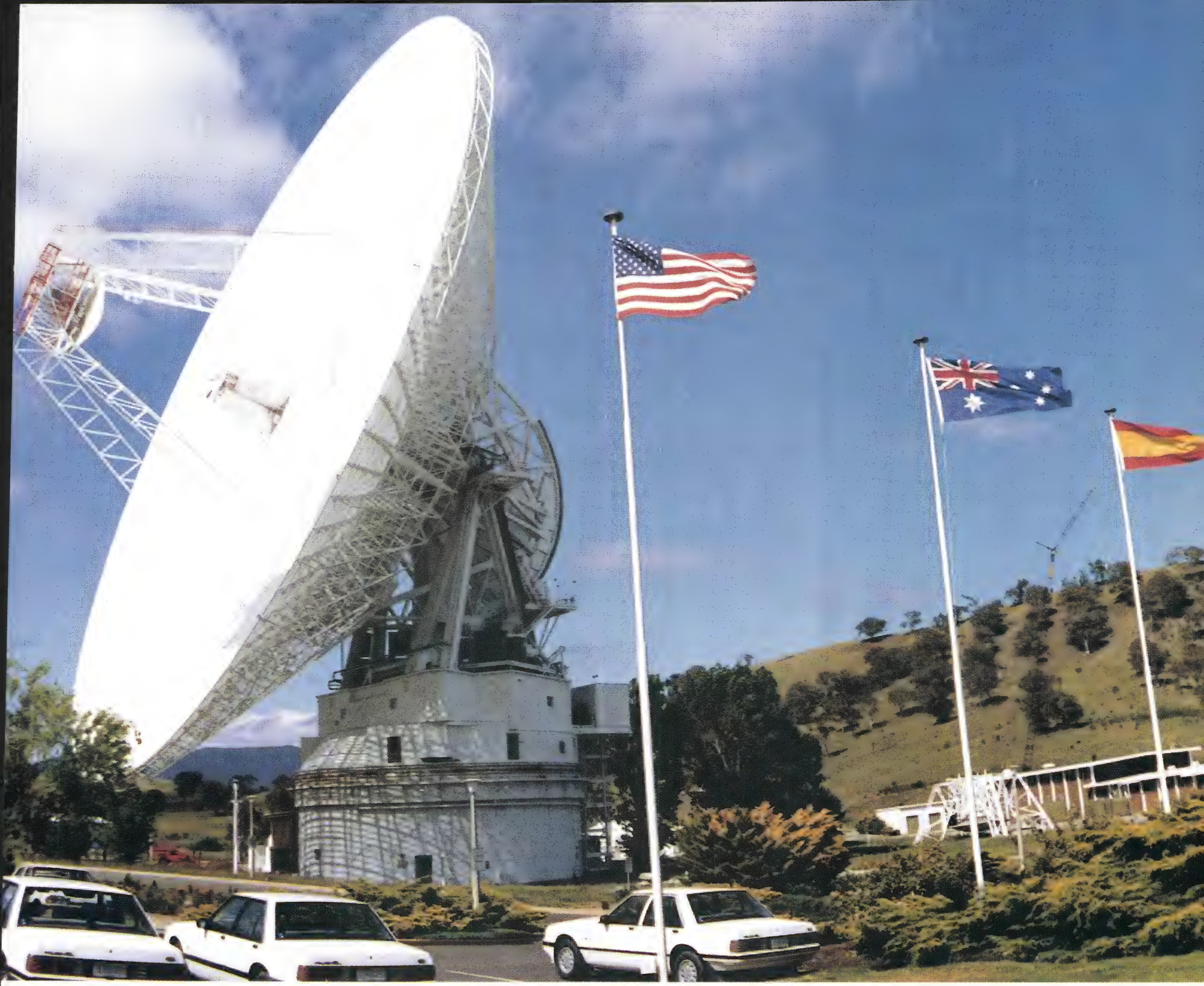
The European complex is located at Robledo de Chavella in the El Escorial region of central Spain, while the Australian complex is located at Tidbinbilla which is 40 kilometres southwest of Canberra.

These three complexes are located approximately 120° apart in longitude, which provides an eight to 14 hour view period at each location and suitable overlap for transferring the spacecraft signal from one complex to the next. To shield against radio-frequency interference, all complexes are located away from population centres, in semi-mountainous bowl shaped terrains.

Each DSN complex comprises four deep space stations equipped with large parabolic reflector antennas and ultra-sensitive receiving systems. There are two 34-metre diameter antennas, one 26-metre antenna and one 70-metre diameter antenna, which is also equipped with a powerful 400-



**Australia's DSN facility at Tidbinbilla. In the centre is the 70-metre dish (DSS43), with the 26m dish (DSS46) at lower left and the two 34m dishes in the background (DSS45 in the centre and DSS42 on the right).**



*The large 70m antenna at the DSN complex at Tidbinbilla in the ACT, with US, Australian and Spanish flags.*

kilowatt transmitter. The Goldstone complex also has an additional 34-metre antenna that is used for Network research and development. At Tidbinbilla, there is also a TDRS remote tracking station to receive real-time data from the Gamma Ray Observatory.

The 70-metre antennas, which are the most sensitive of all the DSN antennas were extended from 64 to 70 metres between the *Voyager 2* encounter with Uranus in 1986 and the Neptune encounter in August 1989. This is the main antenna used at each complex for all deep space activities. The two 34-metre antennas at each complex can be used to support both deep space and Earth orbiting spacecraft. During an outer planet encounter when the spacecraft's signal is extremely weak, the output of both the 70-metre and two 34-metre antennas can be combined to increase the strength of the signal.

In addition and by contrast, there is a 13-centimetre diameter omnidirectional antenna at each complex that receives signals from the US Department of Defence's NAVSTAR satellite Global Positioning System (GPS). The DSN's navigation activities use NAVSTAR signals to measure Earth-platform characteristics, which are needed for calibrating deep space navigation data and determining precise near-Earth satellite orbits.

The stations at each DSN complex are remotely operated from a centralised signal processing centre which houses the electronic subsystems that point the antennas, receive and process telemetry, transmit commands and produce the spacecraft navigation data. All of these activities are monitored and controlled at the complex by a six person crew.

The ground communications facility provides and controls the communications circuits that link each of the three DSN stations to the Network operations Control Centre at the Jet Propulsion Laboratory located in Pasadena, California and to the flight project control centres located in the United States and overseas.

The voice and data traffic between these locations is sent via landlines, submarine cable, terrestrial microwave links and communications satellites. The circuits are leased from common carriers by the NASA Communications Network (NASCOM), and are provided to the Ground Communications Facility as needed. Spacecraft data sent over these lines is checked for transmission errors and outages by error detecting software, which automatically detects and flags any data block received with a ground transmission error.

## Operations centre

The Network Operations Centre at JPL is the 'operations focal point' of the DSN. The control centre staff direct and monitor operations at the three DSN complexes, and verify the performance of the Network with respect to transmitting commands and delivering the amount plus quality of spacecraft telemetry and navigation to Network users. The staff also generates and transmits spacecraft 'view period' schedules, frequency predictions for spacecraft and perform orbit determinations.

The DSN staff at JPL consists of administrative, technical and engineering personnel, assisted by contractor engineers and technicians who are responsible for maintaining the Goldstone communications complex. They are also responsible for operating and maintaining the operations control and ground communications centres at JPL.

The Spanish and Australian facilities are staffed and operated by agencies of the Spanish and Australian governments, and their contractors. In Australia's case, the Australian Space Board oversees the Tidbinbilla complex and British Aerospace (Australia) has the contract to manage and operate it. The total international network staff currently stands at 1600 people.

## Communications vital

Each spacecraft that is designed to explore the solar system is essentially a self contained and self sustaining entity, designed to operate nearly autonomously for extremely long periods of time. Any successful operations require an extensive and equally sophisticated Earth-based communications system for controlling the spacecraft operating modes, loading and reprogramming its computers, navigating to its destination and returning scientific data.

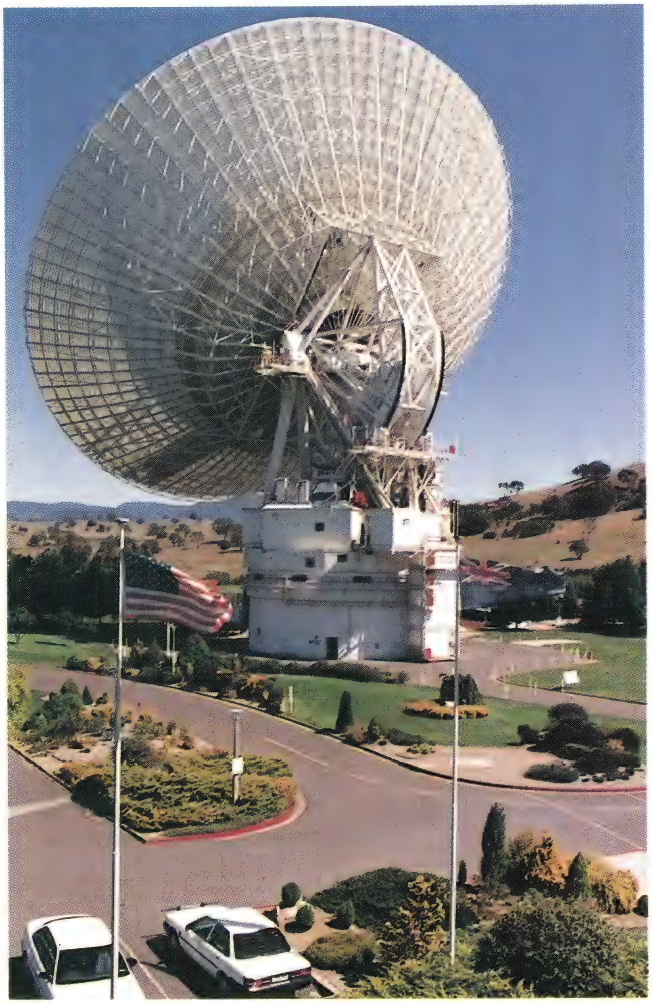
A two-way communications link between Earth and the spacecraft is standard for all NASA deep space missions. Commands are sent on the uplink to control the spacecraft operating modes, and telemetry is sent on the downlink. Both uplink commands and downlink telemetry are coded in digital (binary) form, and sent as a digital bit stream of 1's and 0's. Navigation data is produced by making comparison measurements of the uplink and downlink frequencies, which are then computer processed to provide the spacecraft's range, position and velocity.

The main objective of both the spacecraft and the ground system is to return as much useful scientific data as possible. The key to quality information is the data rate (bits per second) that can be transmitted by the spacecraft and received by the ground system with a minimum of bit errors. The higher the data rate, the more information per second is received — subject to a bit-error rate (BER) which will determine the data quality.

The deep space radio link is basically the same as other point-to-point microwave communications systems, except for one major difference: the incredible distances involved and the resulting ultra low-level signal that the space- craft produces.

The total signal power from a craft at an outer planet that arrives at a network antenna can be as weak as 10 - 19 watts. The weakness of the signal results from the strict restrictions placed on the spacecraft's size, weight and transmitter power, in order to fit into its launch vehicle — whether it be a space shuttle or an expendable rocket.

It is also usually more expensive and difficult to increase transmitter power, which will add further weight to the spacecraft.



***Tidbinbilla's 70m dish as seen from the rear, showing more of the 2700 tonne metal work.***

As a consequence, the design of the radio link is the result of engineering tradeoffs, which accommodate limits on spacecraft transmitter power and antenna diameter by building maximum sensitivity into the ground receiving system.

To save both weight and expense, the spacecraft's transmitter power is usually limited to 20 watts — which is the same power required to light a refrigerator light bulb. To generate even that small amount of power takes 25% of the spacecraft's power supply. The spacecraft's antenna focuses the signal power into a narrow beam aimed at Earth.

For example by the time the beam reaches Earth from Saturn, the beam and power that it contains are spread over an area that has a diameter equivalent to 1000 Earth diameters. As a result of this, the ground antenna is able to intercept only a microscopic part of the signal power.

As the ultra-low level signal enters the antenna, it is degraded by background radio noise which is caused by the spontaneous motion of free electrons occurring within matter. Noise is radiated naturally from all objects in the universe, and unavoidably enters the ground antenna along with the spacecraft signal. In addition to external noise, the operation of the ground receiving station itself also contributes internally generated noise to the process.

If there were no noise sources, an amplifier with sufficient gain could easily increase the signal power to a useable level. Since there will always be noise amplified with the signal, it is the signal-to-noise ratio that makes the critical difference. The main technology elements used to minimise the presence of noise are the use of microwave radio frequencies, noise combating telemetry coding techniques and the state of the art sensitivity of the Deep Space Network antennas and low noise receivers.

There are three radio frequency bands generally used for point-to-point communication — medium wave radio (550-1650kHz), which is used for AM broadcasts; shortwave radio (1650kHz to 30MHz) which is used by amateurs, police, aircraft and CB radios; and VHF/UHF/microwave radio (30 -100,000MHz), used generally for television, FM radio, mobile telephones and data communication networks, radar, Earth orbiting spacecraft and deep space communications.

Microwaves (1000 - 100,000-MHz), also known as 'space waves' or direct waves, propagate in much the same way as a beam of light. A microwave beam that travels in a straight line can be reflected from a smooth surface and can be focused by a lens or a curved reflector to increase its strength.

Because of the higher frequencies involved and the smaller wavelengths, the microwave band can take advantage of 'transmission windows' in the ionosphere which is a region that extends from 113 to 400 kilometres above the Earth's surface. The ionosphere allows certain microwave frequencies to pass easily into outer space. Ionospheric conditions can often have adverse effects but at the 'window' frequencies, the effects are minimised. Rain and water vapour can cause higher frequency microwaves to be attenuated but most importantly, as microwave frequencies increase, the level of unwanted radio noise decreases.

The frequency bands that are currently

used for deep space communications are 2100 - 2300MHz (S-band) and 7145 - 8450MHz (X-band). Higher frequencies between 32 and 34GHz (32,000 - 34,000MHz, or Ka-band) are being developed for future use.

Line of sight communication, high data rates and low noise performance place exceptional demands on ground-based antennas. Both the spacecraft and the ground system use parabolic reflector antennas, whose high gain and efficiency are essential to successful deep space communications.

The gain of an antenna is a measure of its ability to radiate a given amount of radio energy in a single direction, as compared to a theoretical 'isotropic' antenna with a 'ball shaped' directivity pattern, which would radiate the same amount of energy equally in all directions.

It is axiomatic that the larger the diameter and aperture of a parabolic antenna, the narrower and more focused the beam — which results in greater directivity and thus higher gain. The gain and directivity are the same, whether transmitting or receiving.

To receive all deep space frequency wavelengths, which are 13cm for S-band, 3cm for X-band and 1cm for Ka-band, the surface of the receiving antenna must not deviate from an ideal parabola by more than 0.25mm from edge to edge.

This requirement places rigid demands on the design and structural integrity of a large steerable parabolic antenna, which must not warp or bend as it tracks spacecraft across the sky. The total weight of the steerable portion of a DSN 70-metre diameter antenna is 2.7 million kilograms (2700 tonnes!).

Precision pointing of the antenna is also critical. Because of its very narrow beam, the antenna 'sees' only a very small portion of the sky (roughly equivalent to looking at the sky with a drinking straw), and must be pointed at the spacecraft whether it is transmitting or receiving. When receiving, the narrowness of the drinking straw aperture has the advantage of limiting the amount of external noise entering the receiver along with the spacecraft signal.

The low-noise receiver consists of two parts — a 'front end' preamplifier mounted on the antenna at its focal point, and a 'back end' receiver located away from the antenna at the signal processing centre.

## Cryogenic front end

The preamplifier's main purpose is to increase the power of the incoming spacecraft signal as much as possible without adding discernible noise, making the signal strong enough to send via coaxial cables to the remotely located back end receiver for more amplification, detection of the signal carrier and demodulation of the information carrying sub carriers. The first amplification is critical because the increase in signal power makes it possible to ignore the noise generated by the waveguides, the cables and the following receiver.

The key to overcoming these noise sources is a cryogenically cooled MASER (Microwave Amplification by Stimulated Emission of Radiation) amplifier. The core of the maser is a short length of synthetic ruby crystal, which is placed in a strong magnetic field and supercooled with liquid helium as close to absolute zero as possible (-273°C).

The strong magnetic field causes the chromium atoms in the crystal to align themselves with the magnetic lines of force, and to separate into distinct energy levels depending on the spin direction of their electrons. Radiation from the incoming microwave signal causes the higher energy atoms to drop to a lower level and in doing so give off a photon of signal energy. The released photons proceed to stimulate more atoms to emit more photons, which quickly produces an avalanche of photons all of the same frequency and organised to move in the same direction — which amplifies the incoming signal to a much higher level.

Amplification is enhanced by the use of a 'slow wave' structure, which forces the oncoming wave to pass slowly through the ruby crystal, giving it more time for interaction between the wave and the excited atoms. The necessary amplification only takes place if the maser material is cooled to liquid helium temperature. The DSN was one of the first users of maser technology,

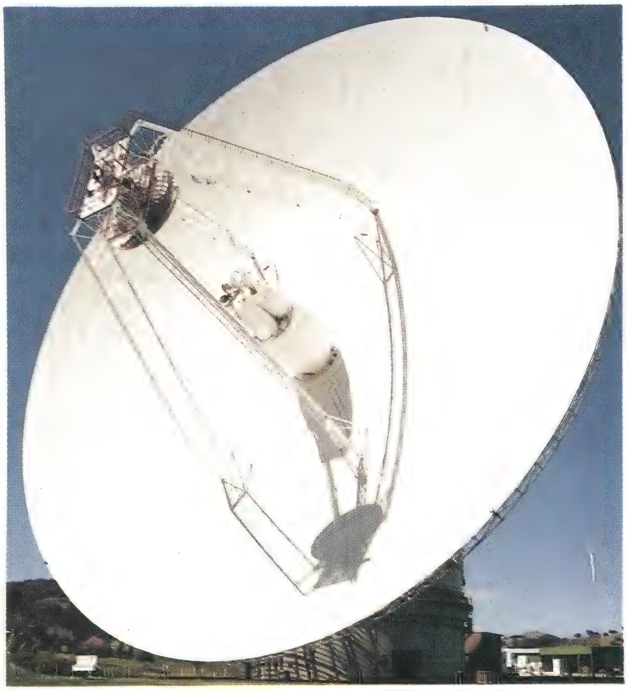
***A close up of the DSS 46 26m antenna at Tidbinbilla.***

***A rear view of DSS45, one of the two 34m antennas.***

and has made significant contributions to the operations of masers in the field.

To assist in the task of maintaining high data rates whilst extending the communications links to the far reaches of the solar system, the DSN has been greatly assisted by forming 'arrays' with non-DSN antennas to achieve the highest possible signal strength.

For the *Voyager 2* encounter with Neptune in August 1989, cooperative agreements with the governments of Australia and Japan provided the use of two 64-metre radio telescopes (one being the CSIRO telescope at Parkes) to form an array with the DSN's Canberra complex. At the same time, the US National Astronomy Observatory's Very Large Array at Soccoro in New Mexico was arrayed with the Goldstone complex. The additional signal capture provided by this arraying made it possible to achieve a data rate of 21.6 kilobytes per second, across a distance of 4.3 billion kilometres.



***A closer look at the feed arrangements for the 70m dish (DSS43). Note the cluster of equipment at the prime focus, behind the secondary mirror.***

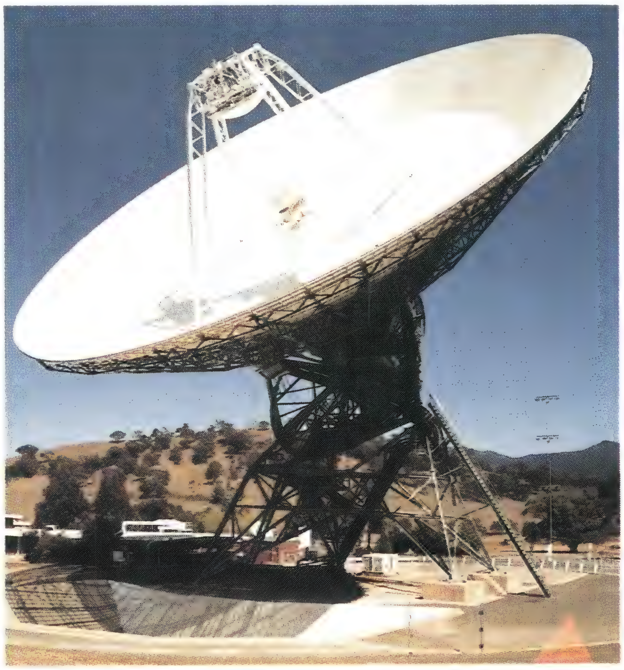
## Impressive record

During 1993, the DSN's typical support load consisted of 12 in-flight deep space missions, 12 Earth orbiting spacecraft, 11 emergency support commitments and two future deep space missions in the planning stage. From 1958 through until the end of 1993, the Deep Space Network has provided principal tracking, telemetry and command support for thirty space projects which involved a total of 74 lunar and planetary spacecraft. Lunar exploration began with *Pioneer 3* and *4* — followed by the Ranger, Surveyor and Lunar Orbiter spacecraft which laid the groundwork for the Apollo program during the late sixties and early seventies.

The first interplanetary encounter that the DSN supported was the *Mariner* series of spacecraft which explored Venus, Mars and Mercury from 1962 onwards. Other prominent planetary missions that the DSN has monitored include the *Viking* spacecraft which landed on Mars, and the *Pioneer* family which have explored both the inner and outer planets.

The Deep Space Network doesn't only support American spacecraft. During *Giotto*'s encounter with Comet Halley in 1986, the DSN provided essential backup support for that and also the International Cometary Explorer. The international spacecraft *Ulysses*, which recently began orbiting the Sun, is also another DSN client.

Possibly the most impressive DSN project has been the *Voyager 1* and *2* spacecraft. Both spacecraft were launched in 1977, visiting Jupiter and Saturn. *Voyager 2* continued the grand tour by visiting Uranus and Neptune also. Because of the distances involved in visiting those two planets, the DSN needed to streamline its operations to get as much out of the two encounters as possible.



***The second 34m antenna (DSS42) uses a different mounting system from DSS45, and has a trench in front to allow clearance at low elevation angles.***

In upcoming years there will be two very interesting challenges for the Deep Space Network: the *Galileo* and Pluto Fast Flyby spacecraft.

Since April 1991, *Galileo*'s high-gain antenna has not been able to open properly, limiting the amount of data that the spacecraft can send back to Earth. It is expected that improvements will be made to DSN antennas so at least 70% of the science value of the high-gain antenna can be salvaged.

Plans are currently under way to devise new data compression and coding techniques to send the data back through the spacecraft's low gain antenna, so as little data as possible will be lost. It is also expected that NASA will use the equivalent of the Russian DSN, to receive further data from *Galileo* on its arrival at Jupiter in December 1995.

The other exciting challenge for the DSN will be the Pluto Fast Flyby spacecraft. Currently scheduled for launch around the end of the decade, the spacecraft needs to arrive at Pluto before 2015, when the atmosphere freezes and collapses — making it impossible to observe anything before the year 2237.

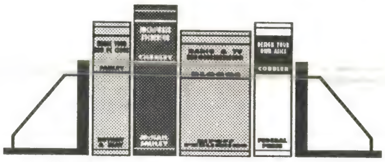
Two spacecraft are expected to be launched, and although data from the planet would be recorded quickly, it would only trickle back to Earth. It is planned to use a 1.47-metre high gain antenna left over from the *Viking* spacecraft. The spacecraft's flight recorder would be capable of holding 400 megabytes but the X-band downlink would allow a data rate of only 25 - 40 bytes per second over a distance of 5.89 billion kilometres.

Another challenge for the Deep Space Network now is communicating with spacecraft outside the solar system. *Pioneer 10* and *11* have both left the solar system and are exploring the universe. In the next 15 years, the two *Voyager* spacecraft will join them, and we will have extended our boundaries even further away from the Earth. Meanwhile back on Earth, the staff of the Deep Space Network will be listening to them, ensuring that they are not alone on their journey into infinity.

In closing, the author wishes to thank Jim Elliott of the Goddard Space Flight Centre, Mary Hardin of the Jet Propulsion Laboratory and Tony Pelling of the DSN facility in Tidbinbilla, for their assistance in the completion of this article.

The illustrations are all courtesy of NASA and DSN Canberra/British Aerospace Australia. ❖

# NEW BOOKS



## Servicing guide

**THE COMPLETE GUIDE TO TROUBLESHOOTING & REPAIRING CONSUMER ELECTRONICS WITHOUT A SCHEMATIC, by Homer L. Davidson. Published by Tab Books (McGraw-Hill), 1994. Soft covers, 234 x 188mm, 285 pages. ISBN 0-07-015650-6. RRP $49.95.**

This book certainly has a long-winded and somewhat grandiose title, but don't let this put you off. It's designed to pass on much of the practical servicing experience gained by its author over more than 45 years at the radio/TV servicing bench, and by and large it seems to do so fairly well. As a great deal of servicing in the real world must often be done without the benefit of a service manual or schematic, this should make it of potential value to many people.

After a couple of introductory chapters talking about basic servicing techniques and tricks, Mr Davidson gets into the details of troubleshooting and repairing audio amps, car radios, cassette players, B&W TV receivers, CD players, colour TVs, power supplies, stereo music players and multiplex stereo FM, and VCRs. Then he ends off the book with 17 specific 'tough dog' servicing case examples, designed to help the reader get a good feel for the techniques discussed in the earlier chapters.

There are plenty of illustrations, including many photos showing the interior of the equipment discussed (all as encountered in the US market, of course, but still informative). Some of the text is rather brief, though; I suspect many of the people who could really benefit from the book will find this a bit frustrating.

The review copy came from McGraw-Hill Australia, of 4 Barcoo Street, Roseville 2069; phone (02) 417 7003. However copies should be available from most technical and larger bookstores. (J.R.)

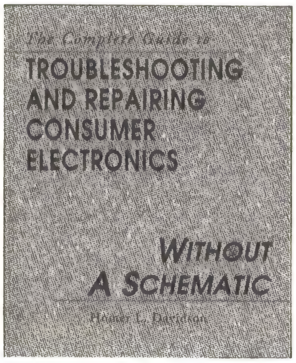
## Practical designing

**THE CIRCUIT DESIGNER'S COMPANION, by Tim Williams. Published by Butterworth-Heinemann, 1991. Soft cover, 155 x 235mm, 302 pages. ISBN 0-7506 1756 X. RRP $45.95.**

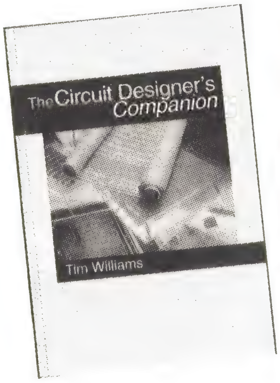
According to the author of this book, electronic circuit design can be divided into two areas: designing a circuit to work in the laboratory, and designing the same thing for the real world. An electronics design engineer with some 20 years experience, he believes the UK education system is failing to meet the needs of industry, particularly when it comes to producing engineers able to design analog circuits. Hence this book.

The subjects covered in this practical and easy to read text include grounding, printed circuit design and layout, the characteristics of practical active and passive components, power supplies, electromagnetic compatibility and safety and thermal management. It's aimed at graduates who, according to the author are 'floored by simple questions such as the nature of the PN junction or how to go about resistor tolerancing.' In other words, it's a compendium of analog and digital design techniques not usually found in an academic text of the subject.

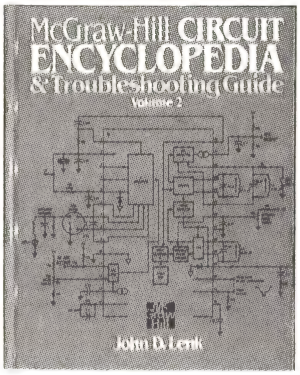
It assumes the reader is technically skilled, if inexperienced, and is relatively free of complex mathematics. Although aimed at analog design, digital circuits are also discussed, with sections on interfacing digital and analog circuits, loading and ESD protection. All practical information, and essential knowledge if a circuit is going to survive in the real world.



The Complete Guide to
TROUBLESHOOTING AND REPAIRING CONSUMER ELECTRONICS
WITHOUT A SCHEMATIC
Homer L. Davidson



The Circuit Designer's Companion
Tim Williams



McGraw-Hill CIRCUIT ENCYCLOPEDIA & Troubleshooting Guide
Volume 2
John D. Lenk

The book gives many practical hints and the writing style is friendly yet appropriate to the subject matter. The review copy came from Butterworth-Heinemann, PO Box 345, North Ryde 2113. It should be available from technical and larger bookshops. (P.P.)

## Applications data

**McGRAW-HILL CIRCUIT ENCYCLOPEDIA & TROUBLESHOOTING GUIDE, Volume 2, by John D. Lenk. Published by McGraw-Hill, 1994. Hard covers, 243 x 192mm, 692 pages. ISBN 0-07-037610-7. RRP $135.**

John D. Lenk is a well known and very prolific US electronics author, with some 78 books to his credit. As the title suggests, this latest addition is a follow-on from an earlier book of the same name, which was apparently very popular.

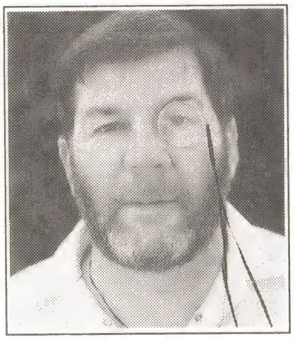
Basically it's a compendium of applications circuits, data and related information for a wide range of ICs and discrete semiconductors, extracted from manufacturers' data books and similar sources. This material is grouped into convenient sections — e.g., basic amplifier circuits, RF and IF circuits, oscillator and generator circuits, classic op-amp circuits, and so on — and augmented by general material on testing and troubleshooting each kind of circuit, provided by the author.

This inevitably produces something of a hotch-potch, with a variety of schematic styles and the occasional puzzling references to diagrams that haven't been included from the original source, etc. But on the whole, there's a lot of very practical information which should make the book of value as a source of ideas (as well as an applications guide to specific devices), for anyone involved in circuit design. And perhaps also, but to a lesser extent, for those involved in troubleshooting equipment using some of the less common devices concerned...

The review copy came from McGraw-Hill Australia, of 4 Barcoo Street, Roseville 2069; phone (02) 417 7003. Copies should be available in technical and larger bookstores. (J.R.) ◆

# Moffat's Madhouse...

by TOM MOFFAT



## What's in a name?

Names are funny things, aren't they? I was just reading about the latest notebook computer from the Dell company, which they chose to call the 'Latitude'.

Why Latitude? Well, according to Dell, it's a notebook computer and notebooks suggest travel — and when you travel you journey to some latitude (and longitude...). Apparently names like Voyager were considered, but Latitude won.

Presumably they thought the computer would sell better as a Latitude than as a Voyager. This interesting bit of information would have come from one of the companies that are being formed to help you name your product. I fully understand the problem, because as this is being written I'm deep in the throes of developing a new weatherfax gadget for use primarily on yachts.

This device is much like the Listening Post II kit I've been selling, although this new one is a stand-alone unit that includes its own microprocessor so it doesn't need an external computer. You plug one end of it into the audio from an SSB radio, and the other end into a small ink-jet printer, and the thing prints out weather maps with the full quality of the original transmission. So it becomes a practical replacement for dedicated marine-fax machines, at a fraction of the price.

Trouble is, what do you call it? A few years ago I designed a similar weatherfax receiver, although the microcomputer and the printer were housed in the same case and the thing was sold as a complete unit. But since it was based on a nine-pin thermal printer (all that was available at the time), the picture quality was well down on a 'proper' marine-fax machine. As well the device was priced quite high so that few units were sold, and the company that made them eventually went under.

Presumably, with the company gone, the name of that fax machine is up for grabs again. But I am inclined to stay away from it because the name carries a stigma... a good product, but at an outrageous price. So what do we call the new project? Nothing, as yet. The area of my filing cabinet where I store all documentation is labelled 'Yacht Fax 1995' for want of a better word. But 'Yacht Fax'? No; it just doesn't sound good to me.

'Listening Post' has been a pretty successful name, since I designed the first Listening Post for *Australian Electronics Monthly* several years ago. Listening Post is exactly what the device is, allowing radio enthusiasts to intercept all sorts of interesting digital communications. But the name sounds far too 'technological' for cruising yachties, who just want the thing to deliver weather pictures with no technical knowledge required. So you see the problem...

There have been some ripper names placed on unsuspecting products. Sometimes Asian manufacturers feel they will be more successful if they tag their products with English-sounding names, even though they don't understand the names themselves. Hence a line of Asian products with the brand name 'Stupid'!

A name may be sensible, but then there can be logo problems. Sitting in my workshop is a useful cardboard carton which once contained boxes of detergent or something. The name of this product is 'White Cloud', and the name is emblazoned upon the carton in large letters. No problem there, but beneath it is the logo: something that looks like Mount Fuji with a big fluffy cloud over it. However the overall effect is of a mushroom cloud, like an atomic bomb. Maybe the stuff is supposed to 'nuke that dirt out'!

But that is nothing compared to some of the brand names being promoted to an unsuspecting Australia. Everyone will of course be familiar with a four-wheel-drive vehicle known as a Pajero. But the first time I saw one of these, with the name Pajero in big letters on the back door, I succumbed to a rather violent laughing fit. Because Pajero, in Spanish, means 'wanker'.

So here were all these big men trundling around in their big macho cars with 'wanker' written on the back. Marvellous! Too good to be true, almost. I remembered from my youth in New Mexico, 'pajero' was one of the insults the Spanish-speaking chicanos used to hurl at us gringos (along with some other choice words which I won't detail here...).

But now Pajero is plastered on the back of all these four-wheel drive cars. That couldn't be right, maybe my memory is slipping. But then one afternoon the ABC's political commentator Paul Lyneham was holding forth on Hobart radio, and during the discussion he said "...and do you know what Pajero really means? It means WANKER!". Right, my recollections were confirmed by a second opinion. But who thought up that name?

Pajero is only small stuff, compared to another word that pops up every time it's desired to promote a 'hip' image. Just this weekend I saw a big pile of videos near the supermarket checkout. They were recordings of concerts by various black blues musicians, under the collective title of 'Mojo Working'. A similar series with the same name was also broadcast on SBS television.

We also have, nationally, the advertising agency 'Mojo', and in Hobart, 'Mojo Hair Design'. There must be 'Mojo's' all over Australia. Well, I'll guarantee there are mojos all over Australia, because mojo is black American slang for 'sexual organ'. And 'working' is what people do with their mojos. So that title 'Mojo Working' becomes a little more deep and meaningful.

The phrase actually comes from a classic black blues song called 'Get Yo' Mojo Workin'. This excellent tune hit the scene around 1953 as I remember, and it was promptly banned by every white-run radio station in America. The black stations, of course, played it with impunity.

So with that rather unique lead-in, we shall now talk about radio broadcasting. Then, and now. The first bit of sad news concerns the loss from the AM airwaves of that much-revered country and western broadcaster in Tamworth known as 2TM. This station was one of the few places in Australia where you could hear good country music regularly, in particular the old stuff like Smoky Dawson and Slim Dusty. There must have been a whole generation of guitar players (including me) who developed their styles listening to these fellows play. And now they're gone, unless you happen to live in Tamworth, because 2TM has migrated to the FM band.

The lure of 2TM inspired me to develop a special long-range AM antenna system which was published in *Electronics Australia* last year. And a couple of months after the article appeared, kaboom!

The station was not usually audible every night; sometimes another station, or stations, would be heard on 2TM's frequency. It eventually seemed that 2TM never appeared, and then I got a letter saying the station had gone to FM. Phooey!

It is a pity, really, that big popular stations shooting to a particular market can't be granted a nice clear channel on AM, and enough power to broadcast nationwide. In my youth in the USA there were big regional stations that covered several states with 50kW on an exclusive channel. And the biggest and best was one that was sort of a semi-pirate: a 500,000 watt monster set up just over the border in Mexico, so as to avoid the American power limit.

The star attraction of this station was an announcer named Wolf Man Jack, and his programming had one and only one target: the youth of America, especially black youth. I thought Wolf Man Jack was fabulous. He would scream and bellow and howl and play the most fantastic music — including 'Get Yo' Mojo Workin'.

We kids would cruise up and down the main drag in our cars, listenin' to the Wolf Man. He'd come out of a record and turn on this real boogie voice and say "Yo' got de Wolf Man, baby". And then he'd howl "OOOWWWWW" and all of us in the cars would howl along with him. Hundreds of thousands of kids, all across America, all cruising along in their cars, howling in unison.

When the Wolf Man got a little bored he'd get on the telephone. His wasn't talk-back, it was talk-forward. Sometimes at three o'clock in the morning he would pick out a phone number at random. When somebody answered, the Wolf Man would say, "I'm phonin' about that couch you've got for sale". And the person on the other end would say "But I ain't got no couch for sale!"

Then the Wolf Man would say "Well, do you have a couch?"

"Well, yes..."

"Would you be willin' to sell it?"

And on it would go, until the Wolf Man had talked this randomly chosen victim into selling his couch, right then and there. He'd arrange to be over in 15 minutes to pick it up, and then at the last instant he'd roar with laughter: "Yeah! The Wolf Man just got ya! OOOWWWWW!" And half of America would howl along with him.

Wolf Man Jack never seemed to sleep. Whenever you tuned in that station you got the Wolf Man, except during the commercial breaks when they were advertising the Hoxie Cancer Clinic or a similar institution that would be forbidden in the USA due to quackery. Everyone wondered who Wolf Man Jack really was, and some thought there were several of him, working in shifts. But, with a voice and style like that, there could only be one Wolf Man.

People forgot that because the station was far away in Mexico you could only hear it at night, and it was obvious the Wolf Man only broadcast at night. He slept during the day, as all good wolf men do.

Should you ever come across a film called *American Graffiti* (out on video), you will see Wolf Man Jack in action. See, mind you, not just hear. So I guess in that film, he was finally unmasked. And when I first saw that face I knew that one prominent rumour was true: Wolf Man Jack was not black at all. He was a Mexican, putting on a black voice and style.

He was, in fact, an announcer named Al Tafoya, who was top dog at my favorite station KLOS in Albuquerque. This station did country and western during the day, and black rhythm and blues at night. They even had live C&W bands come into the studio at lunch time, and I used to regularly wag school to join the studio audience.

At this stage I was playing in a band, which had to be one of the worst bands ever to offend the ears of various parents and friends. Once we got the idea that we could hit the big time if we got ourselves played on radio, just like the country bands did. But there would have been no hope of doing it live in the studio; they'd hear us first and toss us out.

So it was decided to make a recording. Not a tape, but a disc, since radio stations played discs. I had access to one of those ancient home disc recorders that scratched a sound track onto an acetate blank. Note the word 'scratch' — that was the sound you got, which matched our band well.

Then it was time to lean on Al Tafoya to play it. NO!

Well, we wouldn't leave the studio until the disk was played. NO!

But after enough nagging, late at night, with a small audience, Al Tafoya eventually played the disk once, just to shut us up. It was indeed awful, but we were satisfied. And now I can say, with considerable pride, that I am one of the few white guys to ever have his record played by Wolf Man Jack.

But that sort of cheek isn't just restricted to youngsters. One of these days I'll tell you about the time, just last year, when I played a gig with James Morrison at the Wrest Point Casino. We've even got it on video! ❖

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READER INFO NO. 3

# HST SEARCHING FOR PLANETS ON OTHER STARS

An astronomer at Rice University in the USA, making use of the recently repaired Hubble Space Telescope, has uncovered the strongest evidence yet that the process which may form planets is common in our Milky Way galaxy and the universe beyond.

### by GEOFF MCNAMARA

One of the most intriguing challenges facing modern astronomy is the possibility of life elsewhere in the universe. But a prerequisite of life as we know it are planets, and until recently astronomers could only speculate on whether planets existed beyond our own solar system.

Now astronomers using the recently repaired Hubble Space Telescope (HST) have discovered a group of young stars that show all the signs of planetary formation. Dr C. Robert O'Dell of Rice University and his colleague Zheng Wen surveyed 110 newly forming stars in the Great Orion Nebula and observed disks of dusty material — the same stuff that the Earth and the other planets were made from — around more than half of them.

For over a hundred years, astronomers have been debating how *our* solar system formed. All of the theories involve a rotating disk of hydrogen, helium and heavier elements. Over time, the planets condensed out of the 'proto-planetary disk', while the Sun formed in the centre and eventually began to shine.

The intense radiation from the newly born Sun swept the solar system clean of the remaining gases, leaving the family of nine planets, including the Earth, exposed.

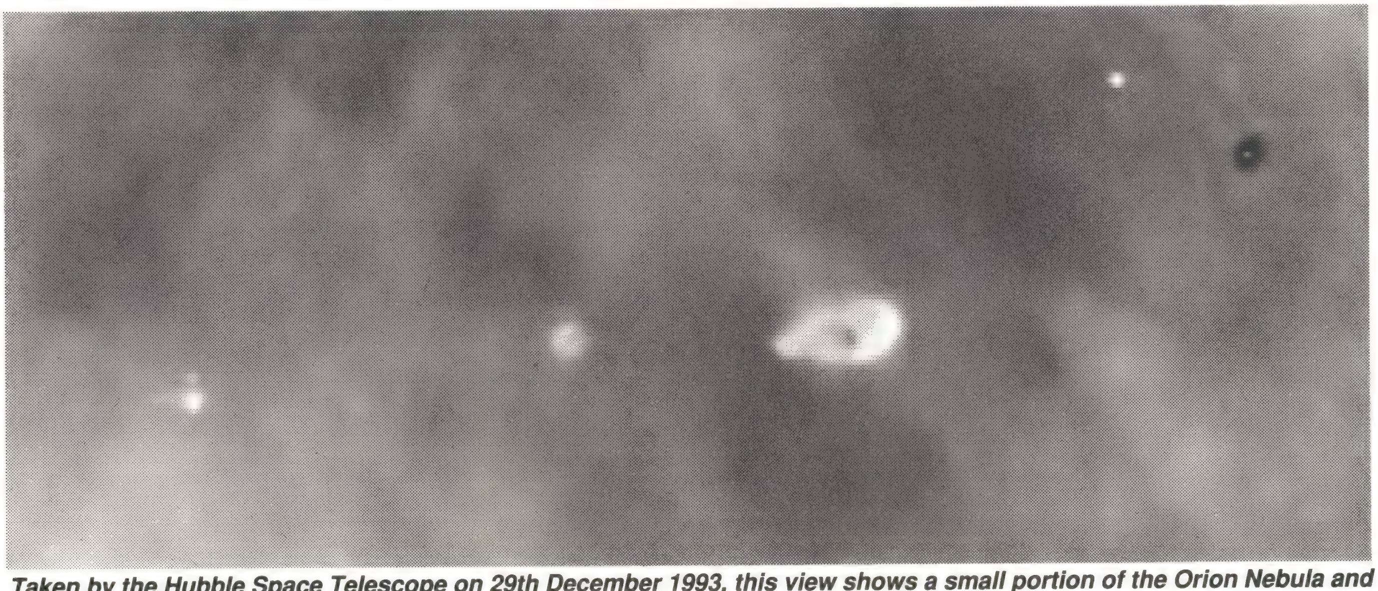
Planets around other stars are difficult to see, because the glare from the stars themselves drowns out the feeble light of any planets that may orbit them. So astronomers look for planets in other ways, such as looking for stars that have proto-planetary disks. Proto-planetary disks are much larger than the solar systems that they form, extending beyond the star's glare.

Until the HST observations, only four stars were known to have proto-planetary disks, the most famous being a star called Beta Pictoris. As a result, there was no indication of how common planetary formation is.

The Hubble observations have changed all that. O'Dell first observed the proto-planetary disks using Hubble in 1992, but the images weren't good enough to convince the skeptics that the stars are surrounded by pancake-shaped disks of dust. The 1994 images show the disks clearly, with the young stars in the centre of the disks. O'Dell has even managed to 'weigh' a portion of one of the disks, and finds that it contains enough material to make an Earth-sized planet.

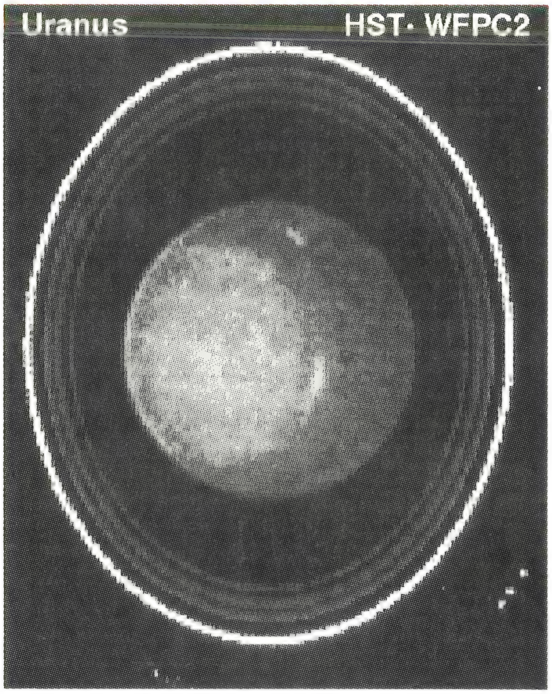
The stars in the Orion Nebula are still young, less than a million years old, and so the planets haven't had time to form. Even some of the stars themselves are still in the process of maturing to the sun-like status that they'll maintain for billions of years. Other stars in the Nebula are more massive, and so have evolved more rapidly. These bright stars are visible using binoculars in the 'Sword' of Orion, perhaps more commonly known to Australians as the handle of the 'Saucepan', an unofficial constellation seen in Australian evening skies during summer.

**BIOGRAPHICAL NOTE**: Geoff McNamara is a Contributing Editor for *Sky & Space* magazine. ❖



***Taken by the Hubble Space Telescope on 29th December 1993, this view shows a small portion of the Orion Nebula and reveals five young stars. Four of the stars are surrounded by gas and dust trapped as the stars formed, but left in orbit around the star. These are possibly proto-planetary disks, or 'proplyds', that might evolve on to agglomerate planets.***

## STOP PRESS: HST IMAGE OF URANUS



***After finalising our news pages for this issue, with its item (page 122) about the Hubble Space Telescope revealing new details of the planet Uranus and its rings, we managed to locate the images concerned on the Internet. A composite of three images taken at six minute intervals with the HST's Wide Field Planetary Camera 2, it shows the rings and clouds, and a triple image of the moon Portia at lower right.***

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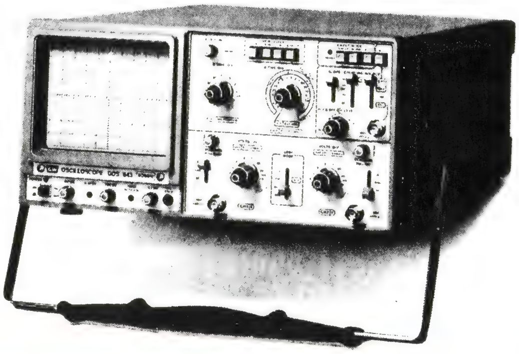

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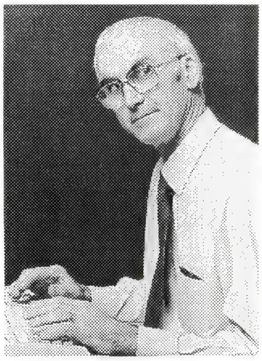
READER INFO NO. 5

# FORUM

Conducted by Jim Rowe



## Who SHOULD determine whether your service technician has sufficient qualifications?

The subject of qualifications and possible licences for electronics service technicians is obviously one that attracts a lot of interest, judging from the letters and faxes that keep on arriving. I've also had two other interesting letters, one discussing problems with a correspondence course, and the other difficulties in getting a job in Australia's electronics industry.

No sooner had the November issue been published, with its further letters on the topic of service technician qualifications, than some more letters and faxes turned up. This topic began, you may recall, when we published a notice in our April 1993 issue to the effect that TETIA had decided not to send us any more 'Fault of the Month' items for the Serviceman column. The notice prompted a response from Mr Robert Heywood, whose comments (and the accompanying comments from myself) made Jim Lawler and his TETIA colleagues very upset. I published Jim's response in the September column.

I'm presenting some of the new comments this month, shortly. However before I do, I'd like you to read part of another letter which came in just after I had prepared the November column. It comes from Mr P.R. Clements, of Dickson in the ACT, who wrote his contribution as a response to Robert Heywood:

*I can throw light on the subject of your concern, i.e., acceptable qualifications for electronics technicians.*

*Over the last 40 years, I have observed a multitude of people with formal qualifications who cannot do the necessary repair work economically. Without rectifying this by hands-on experience, they invariably pressed on with further courses, to end up as unemployable theorists with a sparkling slew of certificates.*

*The other side of the coin reveals an army of dedicated people who devour books and courses with unbounded enthusiasm, albeit with 'dirty hands'. These are the self-taught and basic 'ticket' holders, who formed the mainstay of very busy workshops in the past.*

*The employer's attitude has always been that he requires results, and was by and large ambivalent about certificates — until his opposition's advertising featured the words 'qualified tradesmen', 'expert technician', etc. This first reared its head in a big way in 1959-60, the era of mass TV breakdowns due to 'mud' resistors, leaky paper capacitors, and showers of sparks in hot 'bottles'.*

*The public was ripe and ready for scare tactics, very few believing their TV repairer to be honest!*

*The word 'licensing' trembled from the lips of those with lesser qualifications than the Radio Trades Certificate — now the Electronic Trades Certificate. The tradesmen viewed their hard-won qualifications as being meaningless unless licensing came into being, thus clearing out the backyarders; but who were the backyarders?*

*By the mid to late 1960's, they were the bulk of tradesmen, who could not get a fair wage when the bottom fell out of TV prices in an overcrowded TV repair scene. They decamped to their garden sheds — myself included. We had pressured our employers with hints of industrial action, but realised that it would have been as effective as the great poets' strike of 1958...*

*Pressure groups and conspiracies abounded, to no avail. In the end, Government did nothing about licensing, and is not likely to do anything. The reason then, and now, is that it doesn't get any votes and wouldn't raise a significant sum of money.*

*A little Government intervention could have given my generation the retirement security of the average plumber and drainer, but too much and too soon could have brought the throw-away era forward by 20 years — such was the ratio of qualified to unqualified then, and perhaps now.*

*A little advice, Robert. Don't worry, you have the right spirit. But if you want to take highly profitable, non-qualification to its zenith, keep electronics as a nice little hobby and get into politics.*

Hmmm — thanks for your comments, Mr Clements, and I sense that a lot of that letter comes straight from the heart. I'm not sure whether it will give Robert Heywood much encouragement, but at least it should give him some understanding of where the industry has come from...

### Unfair comments?

Now let's turn to the letters from people responding to the November column. The first of these comes from Mr T. Olajos of Cooma in NSW, who offers some calm and considered comments — but feels that others have been less so: *I have been a reader of your magazine since 1949, the year I came to Australia. It was 'Radio and Hobbies' then.*

*The debate in Forum, on qualifications, caught my interest. Debates of this kind always tend to be emotional.*

*As an unqualified technician, I would appreciate if you allowed me to put in my two bob's worth. (I will leave my cricket bat and bricks at home.)*

*1. I believe that the announcement by Jim Lawler in the April issue was sincere. But as the secretary of TETIA, he had to accept the decision of its members.*

*2. Some of the comments made by A.F. Ransley and Ray Banks are not fair. A technician should be judged by competence and quality of work. Not by qualification only.*

*As you have remarked, it is not always the unqualified technician who learns at the customer's expense. I have done some work for a big name company. I cannot name them for obvious reasons. My job was replacing faulty terminals with reconditioned ones. The reconditioned terminals were in sealed cartons, with quality control seals. It was not un-*

BUT.. CAN YOU CHANGE A FUSE?
QUALIFICATIONS

*usual to find two out of five reconditioned terminals faulty.*

*3. Ray Banks argues that the Fault of the Month encouraged people with no experience to 'have a go', and damage their equipment. The same can be said about The Serviceman, or any magazine like EA, or any book on electronics. Should they be all stopped also?*

*I doubt that a technical description of a fault, and the fix, means much to an inexperienced person. If he is silly enough to have a go, he will do so whether such information is available or not. But so what? It is his money he is wasting.*

*4. I never had the opportunity to get formal qualifications. But I have spent a considerable amount of money, time and effort to educate myself, and I still do, to keep up with technology. I have shelves full of text books, data books and manuals. I have test equipment made by Tektronix, HP and Marconi. Not new, but all in good condition.*

*5. I do not object to written exams, as suggested by Ray Banks.*

Thanks for those comments, Mr Olajos. You're right, of course, that qualifications do not guarantee quality of work, nor minimum expense to the customer. I'm inclined to agree with you that the argument used to justify discontinuing 'Fault of the Month' would also apply to The Serviceman itself, magazines like *EA* and its competitors, and even to textbooks. But hopefully TETIA isn't suggesting that these should *all* be banned, at least just yet...

## Why not TETIA?

Another response to the November column, and in particular Ray Banks' letter, came as a fax from Mr T. Jones of Summerhill in Tasmania. The ID line on the top of the fax said 'From: TETIA Diagnostics BBS/FAX', so presumably Mr Jones is involved in providing diagnostic data for TETIA members. Not surprisingly, he's fairly keen to have us consider TETIA as the body to determine and approve technician qualifications, rather than Ray Banks' Qualifications Board:

*I would like to submit the following for inclusion in the next available Forum.*

*Ray Banks brought up a very well thought out plan to introduce a 'Qualifications Board' in EA (Nov 1994). In doing so, I believe he compromises the bulk of servicing businesses throughout Australia, as he suggests that the entire domestic servicing industry be dissected into TV Tech, VCR Tech, Camera Tech and so on.*

*Firstly, I cannot see how this system could possibly work without throwing otherwise top technicians onto the unemployment scrap heap! Small one-tech businesses cannot possibly specialise in VCR's, just because the fictitious QB says that he is not qualified to repair TV's, Camcorders etc.*

*Mr Banks went on to say that licensing should be extended to a maximum five year period. The basic function of semiconductors does not change as such. However, circuit operations and design do. Being a TETIA Member, he will be aware that Seminars are held regularly to keep Members in step with changing technology. Why not utilise a recognised and respected organisation such as The Electronic Technicians Institute of Australia to implement the suggestions made?*

*The self-employed technician's only real way of remaining abreast of changing technolgy is to stay at the work bench and to attend these specialised seminars.*

*Indeed, the selection process for admittance to TETIA is stringent enough to encompass most of Mr Banks' suggestions. Although, I daresay TETIA Members and non-Members who operate in remote areas and who are basically the 'be all and end all' of domestic repairs in their respective areas would* *have something to say about the separate licensing suggestion.*

*Applying for and becoming a Member of TETIA or TESA does indeed have its merits. No longer does one feel that he has no contact with the trade in general. I can sympathise with folk like Mr Heywood, who have no formal qualifications. There are many people with an aptitude for electronics, and who didn't complete their HSC, or go through an apprenticeship. Some of them, over the years, have been referred to as 'backyard cowboys', even though they may well have been as good as the bloke with 'the bit of paper'!*

*I believe that the domestic service industry is 'closed shop' enough, without introducing a system which further alienates the non-qualified. This closed shop mentality is exemplified when asking some of the larger TV/VCR builders for assistance in repairing one of their units. "Are you a Service Agent?" or "Do you have an account with us?"...No? "Sorry, can't (WON'T) help"!*

*Yes, yes, I can hear you say what about the inexperienced who do damage to customer units, such as the one mentioned in Mr Banks' point number one. Bear in mind the old adage, 'Buyer beware' still applies even when shopping around for a reliable repairer. I think that the system is already in place to cull out the 'useless technicians'. Educating consumers into calling only those who are Members of a recognised and dedicated association such as TETIA or TESA, is surely the most painless way to go for all concerned.*

*With advertising and a more public face, recognised organisations could become a household name. Consumers would eventually be educated into only calling upon a Member technician. Eventually, bad apples would no longer be called upon to wreak havoc with a plumber's soldering iron.*

*Yes, I am an Associate Member of TETIA. I do not have any formal qualifications, but was admitted to the Institute as an Associate and not a full Member, due to 10 years of practical experience prior to admittance. I gained my initial experience not by practising on customers sets, but by purchasing old Pye T29/30's and Philips K9's and working on them. It was a full year of doing this practical, hands-on experience, along with a tonne of theory, before I started work on the real McCoy!*

Thanks for those comments too, Mr Jones. Surprising though it may seem, after thinking about Mr Banks' proposals for a while I'm inclined to agree that rather than set up some sort of separate 'Qualifications Board' it *would* be better to make use of existing industry organisations such as TETIA. I can see your point about the difficulties that would be created by splitting technicians into 'specialties', also.

It's interesting that you are prepared to admit that some of the people without formal qualifications may well be as good at their job as those with the recognised 'bit of paper'. That's the very point I've been making...

## Correspondence course

Now, let's move on, from the question of recognising technical qualifications to problems associated with getting technical knowledge in the first place.

Our next letter comes from Mr Bernard Bechet, of Barnes Bay in Tasmania, and it's fairly self explanatory:

*I have read the comments by yourself and contributors in 'Forum' in the latest issue of EA and I would like to make a few comments. Whether you print them or not doesn't matter.*

*Firstly as a reader of many different technical magazines over the past 40 years, the one factor that I consider to be of importance is the liveliness and frankness of correspondence between the magazine and its readers. I consider it a sign of strength when issues can be aired fully, candidly and without rancour. EA and yourself fall into this category in my opinion, and I always look forward to reading 'Forum' and 'Letters to the Editor'. However I detect a slight dichotomy in policy when I judge the magazine as a whole.*

*Frequent mention is made of having repair work and the like done by professional and recognised technicians, a concept that I have no argument with. But when reading the various articles especially those in 'Projects and Technical' there seems to be an unwritten philosophy of helping the amateur have a go, as it were.*

*I served my time in the building trade and am dismayed to watch TV programmes advocating the average homeowner to have a go with major renovations, simplistically portrayed in an half hour programme, which I know take experience and expertise to do.*

*So what am I trying to say? There must be some middle ground. Quite clearly it would be arrogant and detrimental to the national well being to stifle enterprise and willingness to learn. I believe that publications such as yours are in a position to form a middle ground between the professional and the gifted amateur, perhaps my own case might serve as an example.*

*I have been forced by chronic ill-health into early retirement and although the body is weakening, my mind stays active and the desire to create has not diminished. I tried a few 'Dick Smith' kits which stimulated a desire to learn more about electronics, so I took a correspondence course in elementary electronics. I thought it was a good course and really enjoyed it, but this is where my beef begins.*

*I had occasion to ring the school a couple of times. I got my answers to my questions, but I really felt as if I were intruding, the novice getting above himself. Likewise at the end of the course I asked the question "Where to from here?" To simply receive the reply, scribbled on the flap of the envelope containing my 'certificate of proficiency': 'Keep reading our books'...*

*I wasn't impressed, and wrote and told them so, including some criticisms of the course — constructive I thought, with an order for another kit. I didn't get a reply or the kit.*

*To some extent this attitude has frightened me into doing most of my electronic purchases through the mail, to avoid embarrassment of being talked down to by shop assistants. To be honest this isn't true of all assistants, some have been most helpful. So I have reached a sort of impasse wanting to learn more, but not knowing where to turn. I am confined to home by ill health so cannot attend TAFE or similar courses.*

*I am interested in radio and have read as much basic theory as I can absorb, but now need a greater challenge. But the current comments about the WIA, from both sides of the camp make me hesitant join their ranks. I have scanned all of my catalogues for a kit or schematic, for an amateur radio that would really challenge my skills and teach me something but to no avail. Perhaps something could be published in EA that would fill the gap or maybe there already exists a solution that I do not know of.*

Thanks for your comments, Mr Bechet, and you're quite right about that 'slight dichotomy' in our policy. It has been there for many years, and perhaps it's part of the reason for our survival. We *do* try to occupy the 'middle ground', helping both amateurs and professionals understand more about electronics — and this does get us into trouble with certain groups, from time to time. But at least it keeps things from getting boring, doesn't it?

Your experience with the correspondence course is sad, because it sounds as if your questions were quite reasonable. The comment that you should 'Keep reading our books' was both smug and unhelpful, and like you I'd have been pretty unimpressed too. Still, you'll know which correspondence college *not* to patronise next time...

I sympathise with your dilemma regarding what to try next, though, and we'll try to come up with some projects of the type you seem to need. I'm sure there must be quite a few other people in the same position.

## Jobs in electronics

My last letter for you this month is one that I for one found very saddening. It comes from Mr Jeff Colby, VK3TSY of Grovedale in Victoria, and shows that there's more to getting a job in Australia's electronics industry of 1995 than simply working hard and getting yourself one or more 'bits of paper'. Here's what Mr Colby has to say:

*I am writing to you and your readers in the hope of getting some feedback regarding careers in the electronics industry. Over two years ago I threw in my 'job' to start a 'career' in the electronics industry. I went to TAFE as a mature student and completed a Certificate in Basic Electronics and an Advanced Certificate in Industrial Electronics. Approximately 70 people applied for this course; seventeen gained positions, and apart from myself only two others graduated.*

*In past editorials you have expressed concern at the lack of new people entering the electronics industry. If my experience is typical, I'm not in the least bit surprised. I have kept in touch with a fellow course graduate and his experience is the same. I have since gained employment, but not in the electronics industry, or as a technician, trainee or otherwise — or using any of the skills I learnt at TAFE.*

*The electronics industry seems to make no provision for graduates to enter into it. After making extensive enquiries, it seems that without five years experience there are minimal opportunities. Even with this level of industry experience and a requirement for significant formal qualifications, advertised annual pay rates are often $8000 below the average Australian wage.*

*After putting my family and myself under extreme financial pressure for two years, I really now wonder why I bothered. My advice to any one looking for a career in electronics would be to think again. Any comment or advice from yourself or readers would be greatly appreciated.*

Thanks for those comments, Jeff, and again they're pretty clearly straight from the heart. It's understandable that you're rather skeptical about the industry and its opportunities, after such a depressing lack of success in finding a job — despite getting those qualifications.

I believe there's some truth in what you say about the industry and its attitude towards 'experience', too. Many firms *do* seem to be unwilling to train anyone themselves, and merely want to take on people who've gained their experience 'elsewhere'. And they want to pay even these people as little as possible, as you've noticed. It's a rather cynical attitude, but one that has been around for a while. If anything it seems to have grown stronger, during the recent recession.

Understandably you're a bit browned off regarding my comments in previous leaders, about the lack of interest among young people in fields such as science and electronics. But in a sense, we're both saying much the same thing, don't you think?

Somehow, in Australia fields like electronics seem to be caught in some kind of a vicious circle. Many of the existing companies seem to take a very conservative approach, both with regard to the work they undertake, the people they put on and the money they're prepared to pay them; this discourages people from training and seeking employment in the industry. Lack of effective Government support and scarcity of investment capital also discourages people from starting up their own firms to exploit a 'bright idea'. So it goes on, with more and more equipment and components being imported from overseas, and more exporting of job and career opportunities.

I must confess I don't think there's any simple answer, Jeff; the problem seems too complex. But perhaps one of our readers will come up with a bright idea, and then all we'll have to do is get our politicians to take both it and the problem seriously.

That's all for this month. I hope you'll join me here in the Forum next time. ❖

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# When I Think Back...

by Neville Williams

## Archie Caswell: Radio dealer, serviceman, 'ham' and a modest hero in Japanese POW camps - 1

A local radio dealer and repairman in Queensland during the 'Golden age of radio', Archie Caswell joined the RAAF but ended up as a prisoner in a Japanese POW camp. There he defied his captors by contriving forbidden radio receivers from unlikely oddments, and boosting the morale of his fellow prisoners by intercepting news from allied short-wave broadcasters.

In respect to the Archie Caswell story, our regular 'Think Back' heading is something of a misnomer because, far from being something I remember, the story is as new to me as it probably will be to most readers.

It surfaced only because Darryl Kasch, a radio history buff from Maryborough in Queensland, reacted to a reference in the *Maryborough Chronicle* and followed it up. Thanks to Darryl, to fellow radio historian Ray Kelly and to some of Archie's relatives and friends, it was featured in the Historical Radio Society of Australia's *HRSA Newsletter*.

Darryl Kasch, however, managed to locate and interview Archie's widow — I have a copy of the relevant cassette tape — and was thus able to 'flesh out' the original story. Having done so, he felt that it deserved wider publication; hence this present two-part article. By way of further authentication, Darryl also got to see and decipher Archie's original wartime diary.

### Country born and bred

A.H. ('Archie') Caswell was born in July 1913 in Murgon, Queensland — a township in the Kingaroy area, about 150km NW of Brisbane. The area had reportedly been pioneered by the Caswell family, who had set up their home there, along with a timber mill.

Archie was the youngest of 10 Caswell children and, as such, would appear to have had access to a better education. He attended Murgon State School and subsequently the Ipswich Grammar School. In the meantime, his eldest brother had set up in business in Murgon — fruit, lollies, etc., — and, on leaving school at 15, Archie prevailed on him to set up a sports store, as well.

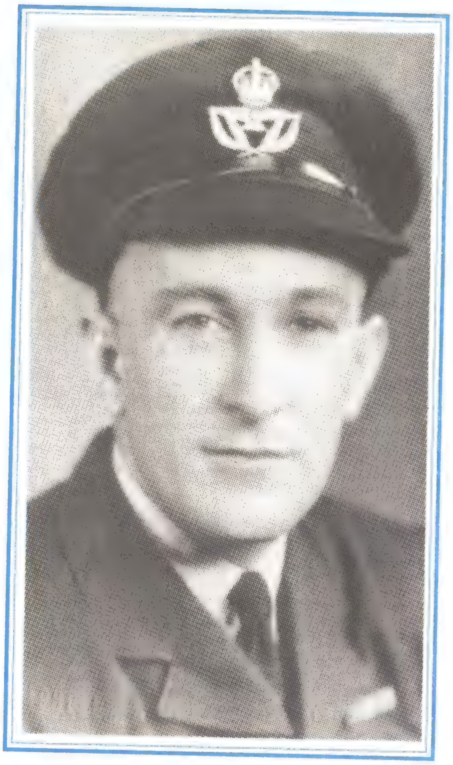


***Fig.1: Archie Caswell pictured in RAAF uniform before the surrender to Japanese forces. Before him lay 3-1/2 years in a POW camp, and work on the infamous Burma railway.***

Archie himself headed off to Brisbane, intent on finding out how to re-string tennis racquets, mend hockey sticks and so on. In truth, his real interests as a teenager were in wireless and aviation, and he subsequently decided to enroll also with the Marconi School of Wireless — completing the course mainly by correspondence, after hours.

Back in Murgon, according to Archie's widow Desley, the new Caswell 'sports' store betrayed these diverse interests by displaying all manner of extraneous 'bits and pieces', including phono records. As well, Archie sat for and obtained an amateur licence, which was put to good use when the bands were open and he could sneak out for a quick QSO!

In due course, the two brothers opened a second 'sports' store in Kingaroy (Bjelke-Petersen country) adding complete wireless receivers to their stock-in-trade. In this setting, Archie became involved quite early in repairing radio sets and putting his Marconi course to good practical use. While references to his pre-war activities are sketchy, the picture that comes through is of a typical country retailer-serviceman, selling his quota of receivers and replacement parts, and responding to service calls from the surrounding area.

Certainly, when he joined the RAAF in 1941, he described himself as a radio mechanic. His personal ambition had been to combine his two major interests and become an airborne radio operator.

The RAAF had other ideas, however, and accepting his 'radio mechanic' status at face value, promptly assigned him to a conversion course as an RAAF Radar Mechanic. As such, he was despatched to Sydney University to study the design and construction of the first wave of Australian-built radar equipment.

## Right place, wrong time!

Following the Uni course, the 'rookie' country-bred Queensland trainee, who had studied top-secret radar in Sydney NSW, was attached to the mainly Melbourne-based No.1 Squadron and posted to Singapore to install radar equipment in American sourced Lockheed Hudson bombers. Three months later, the Squadron was transferred to Palembang in Southern Sumatra, where they operated for barely a week before the Allied Forces based on Singapore capitulated to the Japanese!

Initially, the Unit hoped that they might escape by arranging a *rendez-vous* with Allied shipping at a beach in Java, and RAAF 'sparks' including Warrant Office Caswell reportedly managed to get a radio message through to Australia to that effect. However, for whatever reasons, no rescue ships appeared and Archie and his mates ended up as prisoners of war.

The horrors of the Japanese POW camps and the Burma Railway project have been extensively documented, especially in regard to the work of Dr Edward 'Weary' Dunlop, but little has been said about the role of 'underground' radio in keeping the prisoners informed about the true progress of the war. It was in this area that Archie Caswell made a vital contribution.

Had it been left to Archie, little might ever have been known of his 'underground' radio activities. According to his wife, his attitude on returning home was to blank out the past and get on with the job of re-building his life. The POW camp had robbed him of 3-1/2 years, and he saw no point in reliving the experiences and adding to the deficit. However, she and other acquaintances, including an RAAF mate Fl.Lt. Ken Smith finally convinced him that he owed it to posterity to tell his story. So after a couple of years of badgering, he finally did spend a sequence of evenings at the kitchen table putting pen to paper — literally!

## Archie's own account

What follows is Archie's account of his experiences as a prisoner of war, substantially in his own matter-of-fact prose:

*It was March 1942 and, after being captured by the Japanese in Java, we prisoners were transferred from Garoet to the Capital (Batavia). Here we were imprisoned in barracks then known as the 'Bicycle Camp', named after the Dutch bicycle Brigade previously housed there.*

*After tolerating for a few weeks the spate of rumours circulating in the camp, the troops became very impatient and I remember someone saying: "What's wrong with you radio chaps? Can't you build a receiver to get fair dinkum news?"*

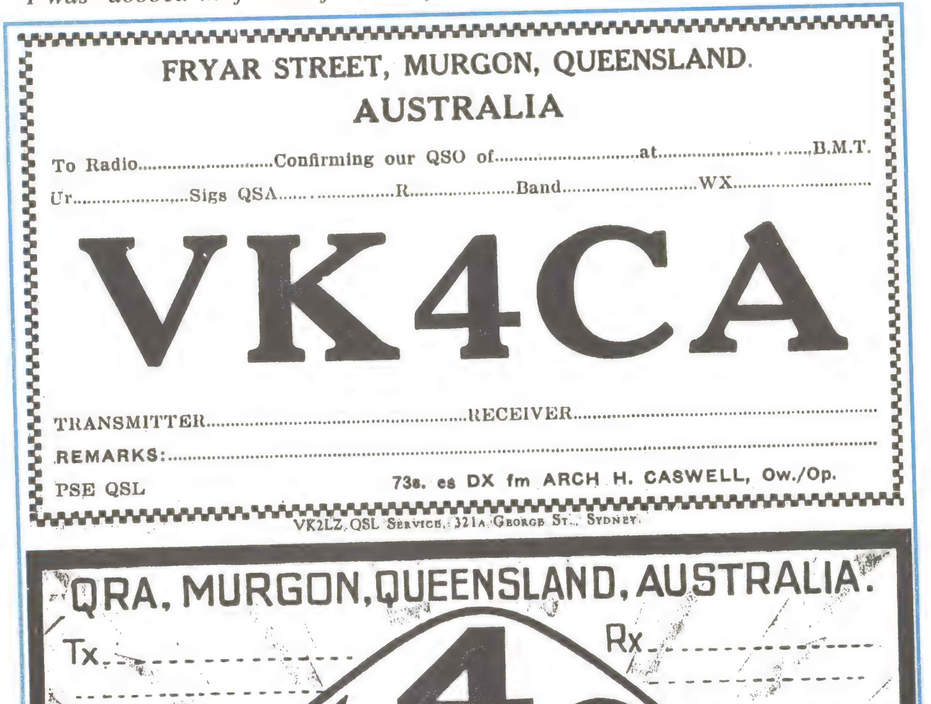
*The natural reply was: "What with? Match sticks?" However, they had made their point and we explained that top priorities for a practical receiver were valves and power supply — preferably batteries. One chap, a few days later said: "Here we are", and produced an enormous graphite-anode transmitting tube. It was not of much use but was hidden away, anyway.*

*It so happened, at the time, that the Japs had been demanding that our camp adjutant nominate a radio mechanic to repair a few radios, in nearby Dutch homes that had been taken over to accommodate Japanese officers.*

*I was 'dobbed in' for the job, to my somewhat dismay. If they discovered that I was an RAAF radar mechanic, I feared that I might 'get the treatment' to reveal what I knew. Fortunately, that did not happen and the first receiver fixed for them was an 'Erres', made in Holland. The fault was a dead RF stage, which I simply bypassed by loosely coupling the antenna to the 'mixer' valve input. This gave me a surplus aerial trimmer, capacitor and resistor, which were quietly removed and brought back into our camp for future use. The next receiver was a Philips (Holland) make, but with nothing 'scroungeable' except a few lengths of wire.*

## Sensitive about news

*While working on this receiver, I accidentally hit a news broadcast from the BBC on 25 metres. I smartly turned the volume down, but the Jap officer must have sensed that it was the News. He strode over and said "Englander"*



FRYAR STREET, MURGON, QUEENSLAND.
AUSTRALIA
To Radio..............................Confirming our QSO of...............................at...............................B.M.T.
Ur........................Sigs QSA.......................R.......................Band..............................WX..............................
VK4CA
TRANSMITTER.........................................................RECEIVER.........................................................
REMARKS:.............................................................................................................................
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At.......E.S.T. were QSA....R.......
T.....ON.....MC. QRM.........QSB.........
73 ES C.U.A.G.N. DE ARCH.H.CASWELL.

**Fig.2: As a spin-off from his course at the Marconi School, Arch qualified early for his amateur 'ticket'. These QSL cards from his personal papers show different callsigns at a different address.**

*When I nodded — Bash! — and I copped one. He made it plain that England was 'no good'; 'Australie' not so bad, but news forbidden anyway!*

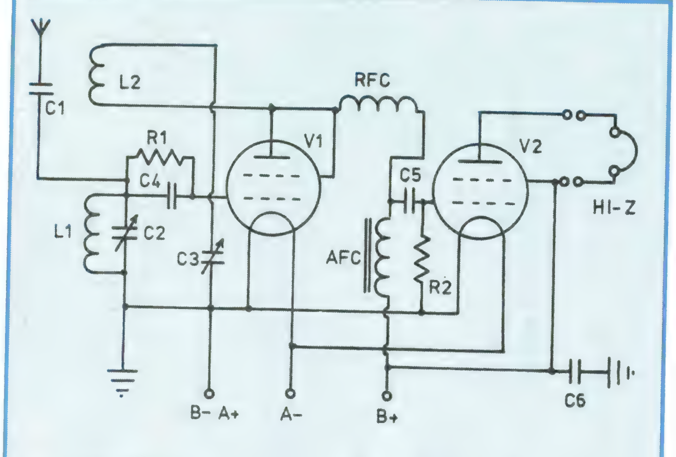
*Another of their receivers yielded a .00025mfd capacitor (plate bypass) and so on. Back in the camp, some progress had been made with 'scrounging parties' organised by my main partner in crime — Brian Breillat (also RAAF).*

*The bright spot was the finding of a 1N5G battery valve, brought in by Frank Huxham. As a pentode RF amplifier with a 1.5V, 50mA filament, it was just what we wanted and, asked where he had found it, he said that there were quite a few in a store in Batavia — but the Jap guards were very alert.*

*A few days later he marched in with two more 1N5's, at quite a risk; but he had eluded the guard search by taping the valves to his privates. You can imagine the chortles and the comments during the retrieval of the two tubes!*

*At this stage we were at last able to give some meaningful thought to the form of radio which would be the least detectable. Work parties were going regularly to the 'Socomomy Vacuum' oil terminal at Tan Jon Priok, a few km away, which was the source of a few useful items: a sheet of tinplate wrapped around my waist, a piece of solder and even a soldering iron. No soldering flux was available, but coconut oil proved to be reasonably effective with the tinplate.*

*The field windings stripped from a car generator provided wire and an old telephone earpiece was swiped from a telephone box. Another airman presented me with a flying helmet complete with headphones, which he had somehow managed to smuggle into the camp.*



**C1** 4 turns twisted enamel wire
**C2** tinplate and wood
**C3** commercial trimmer 0.0001mfd
**C4** 0.00025mfd
**C5** 0.001mfd
**C6** 0.01mfd
**R1** pencil line 1MΩ
**R2** pencil lines 0.5MΩ
**L1** generator wire, about 20 gauge enamel copper, on wax wood former
**L2** a few turns of generator wire on former
**RFC** bunch wound with fine wire
**AFC** fine copper wire wound on a bunch of steel wire, waxed paper insulation

**Fig.3: As represented in the HSRA Newsletter (April 1994), the circuit of the first battery powered receiver contrived by Archie Caswell and other POWs to intercept Allied news broadcasts on the 31 metre band.**

## Time to risk it!

*The situation was beginning to look rosier — despite rumours to the effect that two Dutchmen in Sourabaya and another in Batavia had been sentenced to death for the illegal operation of radio receivers!*

*In the fervent hope that this might be just that — a rumour — Brien Breillat and I decided to rig up a home-made 'dixie' to serve as the chassis and case for a practical receiver, which would be a two-valve affair.*

*The dixie was made a trifle deeper than the Service Issue original, so that the two 1N5's could lie on their sides in the bottom. A false bottom was fitted, leaving a space at the top about one inch deep to hold a layer of cooked rice (our all-day, every-day menu).*

*In the meantime, other volunteers had been collecting standard 1.5V torch cells from Chinese traders or wherever. The objective was to collect a few dozen, on the assumption that we needed about 40 volts to power the receiver. As no (octal) sockets were available, a couple of straps around the waist of each tube, soldered to the tinplate base served to hold them in position. Connections were soldered directly to the pins.*

*The circuit was a common leaky-grid detector used as a triode, because no potentiometer was available to control the screen voltage. The audio stage was wired as a normal pentode (see circuit)...*

*For the detector grid condenser, we used the .00025mfd removed from the Jap officer's receiver, with a pencil line drawn between the terminals to serve as a '2-megohm' resistor. In fact, the carbon track was fiddled from time to time to get the best possible results.*

*For the tuning and reaction coils, we used the generator wire wound on a waxed wooden former (wax by courtesy of Soconomy Vacuum).*

*The tuning capacitor was a crude looking wooden affair made from tinplate with waxed wooden end plates; the wonder was that it worked at all!*

## Success in sight

*Wire stripped from an old transformer was wound in a bunch to form a makeshift RF choke, while more of the same, insulated with waxed paper, was wound over a core provided by short lengths of fencing wire to form a crude audio frequency choke. The receiver had no terminals, because they would have given the game away. Instead, connections to batteries, headphones and aerial relied on different size wires so that connections could be made in the dark. It was decided to concentrate on one shortwave band only, 31 metres being chosen as the best band for all round night-time reception.*

*While construction was in progress, we were gradually accumulating more odds and ends, and where to hide it was becoming a headache. The barracks had a completely tiled floor, so that digging a hole seemed out of the question. However, while lying on the floor one night comparing notes, I found that a 6 x 6-inch tile near my bed seemed a trifle loose; when I tapped it harder, it sounded even more so.*

*Needless to say, we set to work with a knife blade to scratch out the filling around the edge and eventually dislodged the tile to expose the cement below. Each night after that the excavation continued, with the tell-tale cement chips being scattered around the grounds.*

*It was tedious work, with many interruptions. As a precaution we had posted two guards of our own to warn of any Japs headed in our direction. Jap guards could charge through any time of the day or night, and camp rules required that all prisoners must stand to attention when they did so.*

*There were a few near misses, but eventually we had a space of about 1-1/2 cubic feet, a second tile having been dislodged to provided easier access. We also constructed a wooden frame to support the tiles and the weight of anyone who might walk across it. The cavity was lined with the remnants of an old gas cape to keep out moisture, and bar soap was used to seal around the perimeter of the tiles to give the appearance of an untouched floor.*

## 'Underground' radio

*The surplus gear was stowed in the bottom of the excavation, leaving enough space on top to accommodate the receiver and batteries. (Incidentally, if the barracks are still standing, some of the gear is probably still there today!)*

*In the meantime, the final soldering had been completed (in the kitchen) and the radio was ready for an initial try-out. By good luck, the receiver worked. The BBC was finally located and a news bulletin intercepted. Everyone was jubilant!*

*In fact, the signal was marred by a great deal of whistling and scratching. The shielding and construction made reception very touchy, and the regeneration was too fierce. I had to hold the case in my hand to stabilise hand and body capacitance effects. Clearly, modifications were called for.*

*The provision of an adequate aerial also posed a problem. It was solved by unravelling a rope and then re-twisting it, with a length of wire from the generator down the centre. The rope was then strung across the verandah to serve as a clothes line, its role being emphasised by being adorned with sundry pieces of 'washing'. One loose end of the rope just happened to dangle innocently down the wall near the head of my bed, making the end of the wire easy to locate after dark. In fact, the aerial was so well disguised that it survived all inspections and was still in use for its illicit purpose two years later!*

*The receiver itself had meanwhile been 'tamed' quite a lot and many news bulletins were received. These were passed directly to the Commanding Officer of No.1 Squadron, Wing Commander Curly Davis. But the receiver still suffered problems with instability and the effects of humidity and had, at times, to be aired for 5 - 10 minutes before the news to ensure satisfactory regeneration.*

## Improved receiver

*It was therefore decided that the time had come to plan a new model — especially as we had acquired a potentiometer which would allow us to use a pentode-connected detector with variable screen voltage, which should ensure much smoother control of regeneration.*

*As it happened, about this same time, the Japanese had begun selecting various POWs to write letters back to Australia, which were to be broadcast in English from 'Radio Nippon' transmitted on short wave from nearby Batavia.*

*After a few such broadcasts, Allied officers expressed doubts about the validity of the transmitted versions. I was therefore requested to modify the original receiver to monitor Radio Nippon. Handed copies of the original letters, I was requested to indicate any alterations and cross out what was not transmitted. This proved quite a job, because the transmission occurred before lights out and our own guards had to keep a very watchful eye for approaching Japs. However, the marked duplicates indicated clearly that the Japs only transmitted letters which were non-critical of them, and that gave rise to ruses to evade their censorship.*

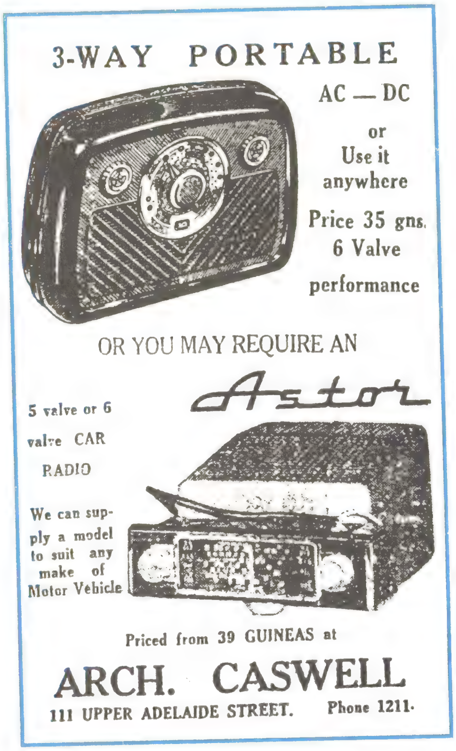


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**Fig.4: As a POW, Archie was a world away from his family, his business and his customers — once accessed by adverts like this in the local papers. But, in the camp, at daunting peril to his life, he defied his captors by contriving and operating forbidden radio receivers.**

*One which went over the air to Melbourne told how the Japanese fed everyone well, treated us kindly, gave us gifts and it was just like being in 'Ringwood'. This obviously went over the heads of Nippon, but the real implication was sensed in Australia.*

*Since quite a few of the POWs could understand 'Nippon' lingo, Brian Breillat decided that we should be able to rig up a simple crystal set to intercept the Batavian tranmissions, if we only had some detecting material. In due course some sheet lead was acquired and a little sulphur, the idea being to make galena by fusing the two together.*

*The problem was how to go about it, and someone suggested that we use the 130-volt mains to get the power. In the process, the lights were mysteriously 'fused' several times; but a small fragment of galena was eventually produced and worked reasonably well — on the 80-metre Nippon station!*

## Receiver in a bottle

*It was decided that the new valve radio would be a three valve affair: RF stage (1N5 pentode); detector (1N5 pentode); audio (1N5 pentode, later wired as a triode). The whole thing would be constructed in a water bottle.*

*Bill Moore, an RAAF radio officer, had come up with the remnants of a command receiver and from this we obtained small coils, a beautiful small ganged variable capacitor and sundry other useful 'bits'. To accommodate the set, we had to fabricate a special water bottle a trifle larger than the issue model.*

*Special harness and felt covers were made to cover the bottle and it looked the perfect fake. The mouth of the bottle had a tube sweated in which went right down to the base, where it was securely soldered, enabling water to be actually poured out in the event of a too-inquisitive search. (The receiver was built on a separate base surrounding the central tube).*

*Variable screen voltage was now incorporated, and anode-bend detection made the receiver work quite smoothly. Tuning was from the bottom by slotted shaft, and the better materials ensured improved sensitivity. Twisted wire connections were retained in preference to terminals, serving also to minimise bulk.*

*(At this point, I should mention that thanks were due to an Army friend Ray Single, who helped quite a bit).*

*A lesson learned in Java was that all news had to be controlled. Hut mates were a source of concern if they tended to discuss the news too openly or too loudly, betraying their subject by words like 'Coral Sea' which were liable to be picked up by the Jap guards. Hut searches became uncomfortably frequent as a result..*

*Dissemination of the news was from myself to Flt. Lieut. Ken Smith and the CO of the unit, who would then disseminate it to the Company of 'Kumi' officers — a much better result than relying on casual conversation.*

We'll continue the Archie Caswell story next month.

*(To be continued)* ❖

# THE SERVICEMAN

## 'The Tape Duplicator From Hell'

I have only one story for you this month, but it's a very interesting and unusual one — contributed by a colleague who is involved in servicing equipment used in the radio and TV broadcasting industries. It concerns his experiences with a 'classic' Ampex high speed 1/4" audio tape duplicating system, still used every day to produce copies of radio programmes for distribution to radio stations all over Australia...

This rather special servicing story comes from Bryce Templeton, a service technician in Sydney who makes a specialty of looking after the equipment used in the radio and TV broadcasting industries. Recently he was called to a firm called Independent Radio Services, to service a wonderful old 1/4" tape duplicator which is still used every day by IRS and its associated firm Grace Gibson Productions to produce copies of programmes for distribution to radio stations — and he thought we'd all find his experiences of interest. *I* certainly did, and I think you will too.

By the way, we're grateful to Mr Bruce Ferrier, the manager of IRS, for giving us permission to discuss his duplicating equipment in this rather intimate way. Mr Ferrier stressed that although the equipment *is* now quite elderly, it still gives sterling service producing large numbers of programme tapes for use by radio stations around the country. In fact he says that with Bryce Templeton's help, it's now working harder than ever before — and producing tapes of a quality that more than meets the requirements of the radio stations.

IRS produces radio programmes such as 'Dr Wright', 'On This Day' and 'The Year My Country Broke', while Grace Gibson Productions is of course famous for its library containing classic radio serials like 'Portia Faces Life' and 'Yes, What?' — which are still very popular. Some of their historic material has been released on CD for collectors, I believe.

Anyway, that's enough preamble from me. Now let's pass the microphone over to Bryce Templeton, to tell his story:

*I began to get suspicious of this job when 'Tape Duplicator' was mentioned. I had last seen one of these about 20 years ago, in the old studios of 2GB in Philip street in Sydney. A wonder of mechanical engineering it was too, but deep in its relay-ridden psyche was a diabolical hatred of strangers.*

*Oh, sure — it looked docile enough when it was in the hands of its regular operator, or maybe 'trainer' is the correct word. But when it felt the timid hands of a new operator, or even worse a technician on its controls, it was like a lion unleashed. In the twinkling of an eye, it could fill the room up with very short pieces of tape. It could change the dimensions of a reel of an irreplaceable programme from 1/4" by 1200 feet to 1/16" by some miles...*

*These thoughts were dancing through my head as I drove over to inspect the 'Tape Duplicator'. Surely it would be a cassette duplicator in this day and age, I reassured myself.*

*My worst fears were confirmed. "Bought it from 2GB about 15 years ago", said the proud owner. "Worked so well that I bought another from 2CH."*

*We went into the lion's den. There it was, exactly the same as I remembered it, except that now it was bigger. The two machines were combined into one; it was The Duplicator from Hell. Well, so that is a little dramatic, but there it was. Apart from stereo heads, it looked exactly the same.*

*Manufactured in the 1950's and early 60's by the Ampex Corporation of the USA, these machines were based on the Ampex 350 series 1/4" tape recorder/reproducer — extremely popular models which were produced for about 20 years.*

*Originally using octal-based valves and selenium rectifiers, and later with 9-pin miniature valves and silicon rectifiers, they were the ultimate in non-sophistication. With large, heavy mains operated motors and a 'servo-system' that consisted of giant relays and 50-watt resistors that would not be out of place in a power station, they were built for years of service. Their construction can be likened to the proverbial battleship...*

### Beautifully made...

*But whatever they lacked in electronic wizardry was compensated tenfold by their mechanical construction. The bearings used were the finest available, with the tolerances of the flutter idler, capstan, and pressure roller giving them wow and flutter figures that many modern recorders still cannot beat. Unless there is something obviously wrong, these same figures can still be obtained today — 40 years after they were built.*

*The duplicators differed from ordinary recorders in that they ran at 30" or 60" per second, and so could copy a 30-minute 7.5ips tape in under four minutes. Up to 30 slaves may be connected to one master, but in this case there were thankfully only seven.*

*There are no electronics in the slaves;*

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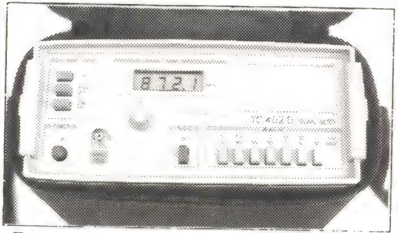

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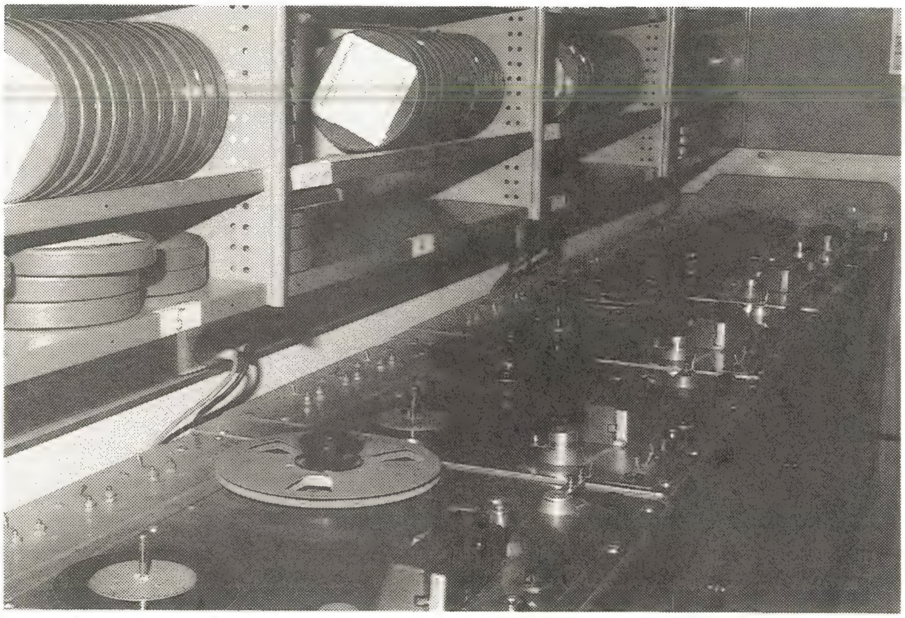
all the signal processing is done in the master machine. This has two playback amplifiers, two audio driver stages and what must be the world's biggest bias oscillator. The playback preamps, located in the base of the master unit were in their day the ultimate in low noise amplifiers. Sadly technology has left them far behind, but they are adequate. The driver amps are fairly conventional and still do a good job, but it is the bias oscillator that really takes the cake. This can put many broadcast stations to shame, providing about 20 watts of 350kHz.

The audio and bias signals are simply looped from slave to slave, with each slave tapping off the required amount of each signal via potentiometers. The impedance of the common bias line, which is unbalanced, is low enough to prevent cross-talk between channels.

Originally the master had two separate heads and two playback and driver amplifiers, one for the upper track and one for the lower track, which would actually be playing backwards. Since these were two separate mono tracks, the offset between the heads did not matter. The master has no recording or erasing facilities. The slaves also originally had two separate half-track heads, one for the upper track and one for the lower, and so the system could duplicate both halves of a two-track mono tape simultaneously. They were fitted with full track heads as well, so could record a full track tape that the master would play to them via its upper track head. The slaves only record; they have no playback or erase capability.



**This photo shows five of the duplicator's seven slave decks.**

## List of faults

Erin, the young tamer of these beasts, had a list of things that were wrong, mainly to do with tape handling. The second master unit, kept as a spare, was not functioning in one channel. I decided to tackle the hardest first and headed for the slaves.

The first one was fairly simple; the machine ran slowly or stopped altogether. The capstan was easy to stop by hand.

In the original 350-series recorders the tape was driven directly by the capstan motor shaft (direct drive — very popular now, but revolutionary then) but, because the duplicators run so fast, their tape drive is a large (20mm) diameter capstan with a heavy 200mm flywheel attached, driven via a tyre on its rim by the motor. In this case the solenoid that pulled the motor onto the tyre needed adjustment. This was adjusted until the tyre was compressed enough to result in the correct speed, as shown by a stroboscope attached to the capstan.

The second machine was not so simple. The take-up reel would slow, causing the tape to spill and so shut off the deck with the safety switch. I peered up at the motor from under the deck. It is an induction motor, with the shaft extended at both ends. The top end has the spool turntable pinned onto it, while the lower end has a brake assembly with a solenoid operated brake band.

It appeared OK from where I sat, so I decided to pull it out, considering the possibility of shorted turns causing a weak motor. This involves lifting up the deck, a job Big Arnie would not relish. Since Arnie wasn't around, the usual procedure is to take out the screws around the edge and then lever the deck up enough to get your fingers under it, lift it up, and place a carefully made stick under it before it comes down again and chops off your hand.

The deck was duly raised and I examined the motor. The problem became obvious — the screws holding the motor together had come loose, allowing the brake band to drag on the drum. Of course these screws were not accessible without removing the motor, so out it came.

It was just possible to tighten the four bolts without removing the spool

**A view of the two master tape decks, with the main one of the left. The panel with the two meters on it is the front of the master record electronics unit.**

*turntable. When replaced it operated perfectly.*

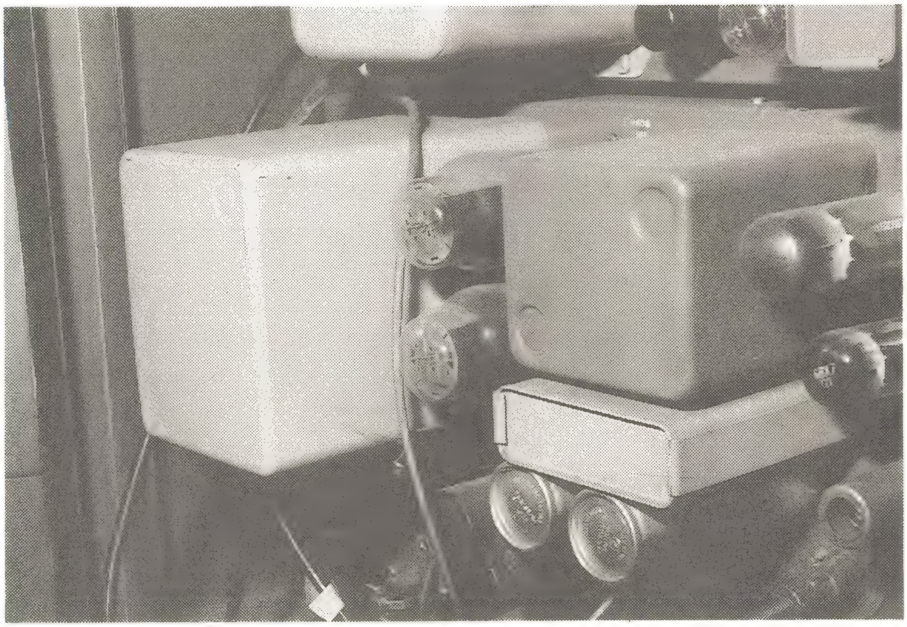
*On to machine three. This had a similar complaint to number two; on start-up the tape tended to spill off the take-up reel and shut the deck down.*

## Starting procedure

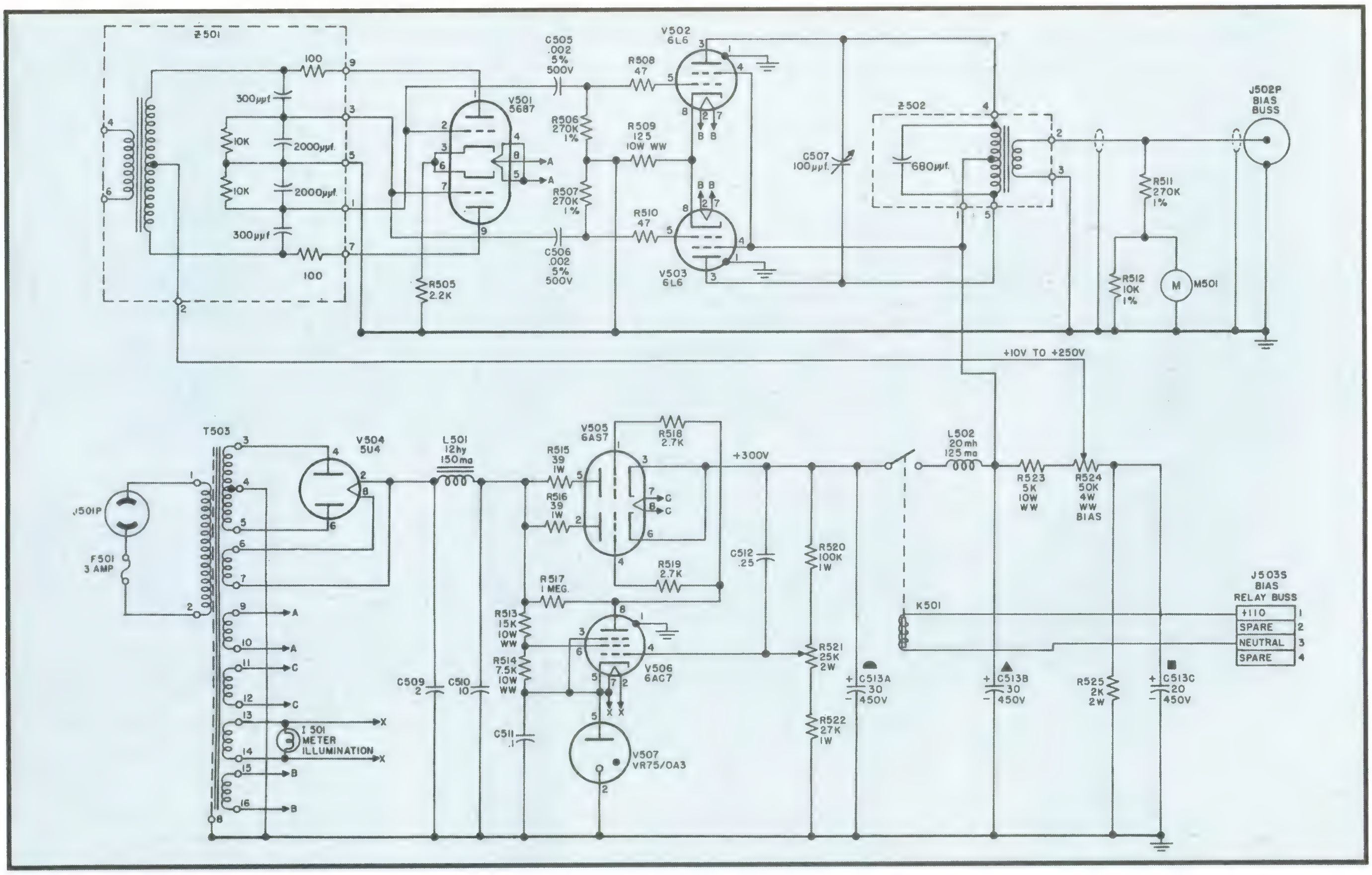
*An explanation of the way the system starts up is in order here. Once the slaves and master are loaded with tapes, the start button on the master causes all the pinch rollers to pull in onto the capstans, which are rotating at normal operating speed. The capstan flywheels then do their job of returning stored energy, and the tape is accelerated from rest to 60" per second in the twinkling of an eye. At the same time the supply spool motors have a low voltage applied to provide back tension.*

*The take-up spool motors, on the other hand, each have the rather difficult job of taking up all this tape that is suddenly emerging from the capstan at an alarming rate. To help with this, a relay switches full mains voltage to the motor for about one second on start-up, and an elaborate spring loaded arm tries to deal with the tape until the motor can get going. After the one second delay the take-up motor reverts to normal torque, as set by the previously mentioned 50W resistors.*

*This lack of elegance in the supply and take-up torque department does cause problems. The same voltage is applied to the motors regardless of the amount of tape on the spools; but the diameter, and so the tape tension, varies by a ratio of about four to one on a 250mm spool. Thus the tape tension is always a compromise — too low when the spool is full, too high when the spool is empty.*



**A rear view of the master unit's record electronics module.**



**How's this for a tape recording bias amplifier? The push/pull 6L6 valves deliver approximately 20W, for all of the slave deck recording heads. Note the regulated power supply — the duplicator is beautifully engineered.**

Back to the problem at hand. The take-up spool motor seemed to be weak and unable to provide the required peak torque at the crucial moment. I removed it from the deck and examined it, measuring the resistance of the windings, but all looked well. I tried a new capacitor, but still no luck.

Since there were no spare motors, I decided to swap the take-up and supply units, reasoning that the supply motor did not have the high torque requirements of the take-up. The motors are identical, even though they rotate in opposite directions, this being taken care of in the connecting plugs.

With the motors swapped over and the deck carefully lowered, I did a test and it worked. I don't know what is wrong with the motor, but it looks like it does not matter. And I had retained all my fingers!

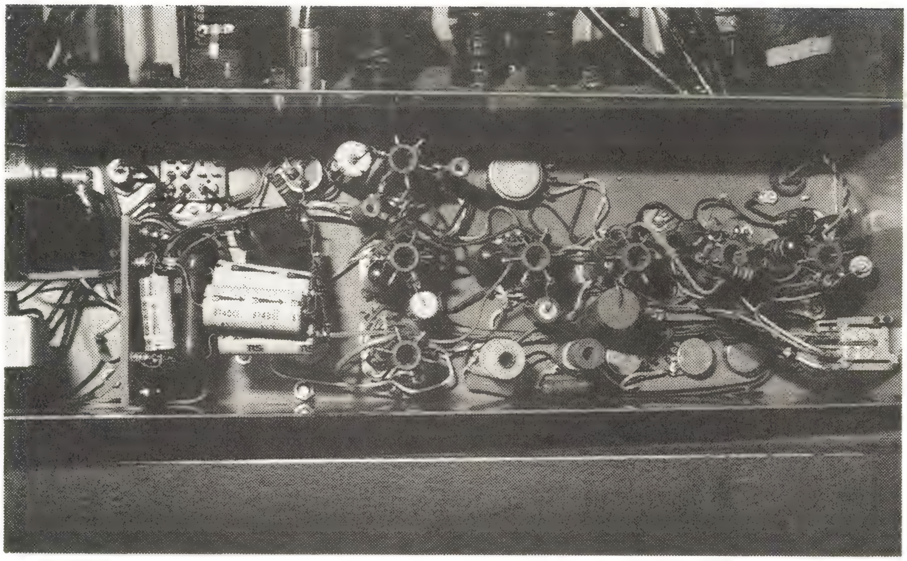
On to slave number four. This would allow the tape to run off the pinch roller on starting, causing much graunching and breaking of the tape. I suspected the pinch roller itself, as examination showed it to be convex in shape where it contacted the capstan. Pinch rollers often erode like this, with more wear in the area in direct contact with the capstan than in the part that is in contact with the tape. This causes higher pressure in the centre than at the edges, and tends to squeeze the tape up or down.

I found a replacement and fitted it, but the results were not encouraging. It still damaged the tape about every third or fourth start. The atmosphere was beginning to thicken with bits of tape...

I examined the roller again. This time I noticed that the pinch roller shaft was badly worn. This was duly replaced from the diminishing stock of parts, and success was mine. The wear on the shaft was probably causing the roller to contact the capstan with higher pressure at the top than at the bottom.

While I was repairing this fault I noticed an even more alarming one in that the safety switch would stick on — thus causing the deck not to stop if something went wrong. It does not take long for there to be a severe space problem in the room, if the tape is not being taken up and the capstan continues to spew it out!

This switch sticking was caused by wear on the switch arm, causing it to bind on the housing. A search of the parts bins produced a new one, and it was fitted. But this is infinitely easier to say than it was to do. It involved lying on my back with my head stuck into the cabinet, in the manner of one who is trying to do away with oneself in a gas oven, and undoing screws that would then descend to parts unknown. Anyway it was accomplished, and operated properly.



**Underneath one of the low noise playback amplifiers.**

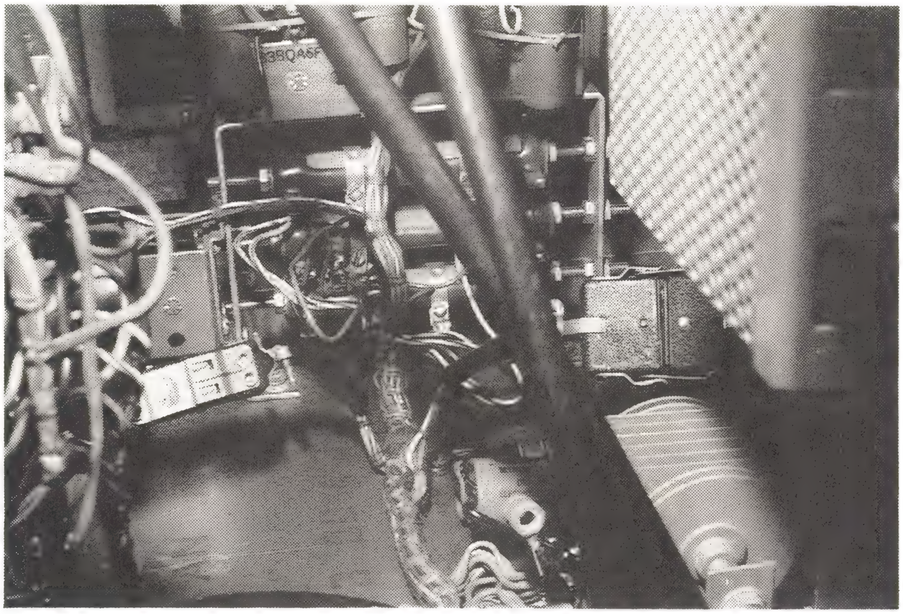
Fault number five brought me out in a cold sweat. Tapes recorded on this deck and played back in stereo sounded OK, but if played back in mono, the top end response was very poor. This is the symptom of a head phase error.

These decks had been fitted with professional format full track stereo heads, in place of the original two separate half track heads. The full track head was still present, but so worn as to be unusable and really just acting as a tape guide.

A head phase error is really the same as an azimuth error, but not as detrimental. It is the result of the head gaps not being at exactly 90° to the tape. At short wavelengths (high frequencies) this results in material that is identical on both tracks being 180 degrees out of phase and thus cancelling if the two tracks are added — as they are when replayed in mono.

Normally this would be the work of a moment. Connect a phase meter or CRO in X/Y mode to the outputs, play a frequency response tape and adjust the azimuth of the head for zero phase error at all the higher frequencies on the tape (above about 4kHz).

It is important to check it at a number of frequencies, as it is easily possible to get it perfect at say 15kHz and have it



**Underneath a slave deck, with some of the 50W tension control resistors visible just behind the two fat cables in the centre.**

*180 degrees out at about 6kHz. It is also possible to adjust it using a tape of white or pink noise.*

## Azimuth adjustment?

*In this case however, there are no play heads or amplifiers in the slaves. The repair manual suggests that the tape be threaded so that it is recorded on the slave, then goes to the master to be played back. This was just not possible the way these machines are set up. The loop would have to be about four metres long, and go around a corner and up a slight hill to get to the master...*

*There had to be a better way, so I went home to cogitate.*

*I had a flash of brilliance. Even though the head was a recording head, it would still play back if connected to a suitable amplifier. I rushed to my friendly Jaycar store and bought a kitset stereo preamp and built it, modifying it for a wider frequency response. Then, armed with a two-channel CRO and my new preamp, I returned to the creature's lair.*

*The heads connect separately to a panel at the back of each slave, via military style screw-on Amphenol connectors; so it was easy to undo them and to connect them to the preamp with bits of wire stuck into the sockets. I connected the CRO, set to X and Y, and a set of headphones (to keep track of where I was on the reference tape, although it is hard to understand the man when he talks at eight times normal speed) to the outputs of the new preamp and switched on.*

*I was greeted with a loud hum, but this was cured by fitting an earth wire from the zero-volt line of the preamp to the frame of the slave.*

*First I played the 20Hz section of the tape, to see where zero phase error should lie on the display. Since we were running at eight times speed, this came out at 160Hz. It produced a line from about 10 o'clock to about 4 o'clock on the CRO face. (The 160Hz wavelength is so long that it is impossible to have a phase error under normal circumstances.)*

*I then spooled through to 1kHz (sped up to 8kHz) and checked. It seemed OK, so I tried at 10kHz. Here the gain was much reduced, probably due both to the larger head gap in the recording head than a play head and to my little preamp running out of response — after all, we were now looking at 80kHz. I carefully adjusted the gains on the CRO and I had a line from 2 o'clock to 8 o'clock, indicating about 180 degrees out.*

*I adjusted the head azimuth screw to correct this, and spooled back to 4kHz. Now this showed an error. After much spooling and adjusting, and checking and spooling, etc., I finally seemed to have the phase correct at any frequency. I disconnected everything and duplicated a section of one of the program master tapes. When played back on the trusty Revox, it sounded perfect whether in mono or stereo. Whew!*

*The last problem, that of the spare recording amplifier not working, turned out to be a 12SH7 valve. There were a couple in the spares bin, still in their US Army wartime boxes but perfectly OK. I understand that the price of new 12SH7's now is in the vicinity of $100 each...*

## In conclusion

*I think that it is good to see that an old piece of equipment like this can still hold its own in a commercial environment. It earns its keep every day, producing 200 - 300 copies a week, and probably will for some time yet — until some newfangled digital system finally overtakes it.*

*Why do they persist with 1/4" tape? Well, it is still very much the workhorse medium of the radio industry. When used under radio station conditions, it requires a very expensive cassette recorder and meticulous maintenance to even approach the performance of a full track stereo 1/4" recorder. The lifespan of the machine, and ease of tape handling and cueing ability all come into the decision to stick to 1/4".*

*It would appear that the next step will be Mini Discs, or another type of removable media hard disk recorders. But this step can only be taken after the industry is sure that the system is a standard, and that a disk sent anywhere in the world can be replayed with a minimum of fuss — and of course, that high speed duplication is possible.*

Well, there you are. That was a different kind of servicing story, wasn't it? My thanks to Bryce Templeton for sending it in, and I trust everyone enjoyed reading it as much as I did. I'm still chuckling about his description of the scene when he was replacing the worn safety switch arm, with his head stuck into the bowels of the slave tape unit cabinet. Fixing some models of TV receiver can be just as awkward!

And that's it for this month. I hope you'll join me again next month, for some more stories from the service bench. ❖

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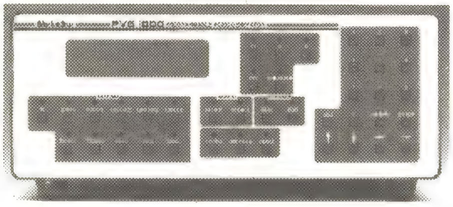

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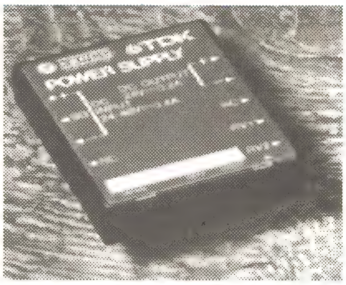

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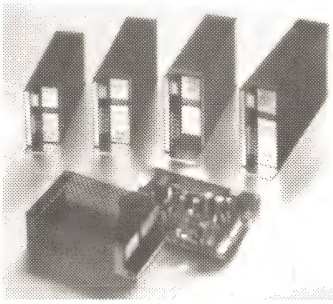

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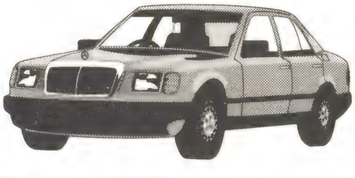


**with NICK de VRIES** MIAME, AMSAE.

## An Australian-designed and built ECU

This month your intrepid columnist reports on the evolution of Injec Racing Development's EM1 digital engine management system, designed and built right here in Australia. This is the same company that supplied the engine control systems for the successful Vimy 19/94 flight...

I first met one of the directors of Injec Racing, Phil Lamovie, back in 1989 — well before Injec had begun to design their first prototype 'analog' model.

We have kept in touch over the years and I have followed the development of this technology with interest.

First up, let's retrace the history of the company to their first analog fuel injection control unit. In 1991 Jeff Dolheguy, an electronics technician from Shepparton, Victoria, began playing with a design for a fuel injection system to fit to a vehicle that had not been fuel injected when it left the factory.

He realised that he needed extensive knowledge about fuel injection and engine management requirements, as well as a comprehensive array of engineering equipment to complete the task. It was therefore a fortuitous meeting that brought him in contact with the well-equipped motor service/engineering garage run by Phil Lamovie, in Melbourne's Airport West.

In conjunction with Phil's Sun Roadamatic Mk4 chassis dynomometer and MEA1500 tunescope, the pair were able to establish their design criteria and also fully test the prototypes under all kinds of load and speed conditions.

The first design was, as I mentioned earlier, an analog device and could be simply described as a 'pulse width modulated graphic equaliser'. Each adjustment had its own trimpot and LED to identify the rpm range for adjustment, etc.

Parameters such as turbo boost compensation could be tuned in, but the success of the installation depended largely upon the ability of the technician concerned.

This early design was mildly successful, with about 300 units sold. Various difficulties were encountered, such as temperature related drift in the linear amplifiers, trimpots often damaged by hamfisted operators using screwdrivers too large for the job — plus the apparent unwillingness of many users to read the handbook first, and consequently cooking the innards!

As with most good ideas, they realised that the design could be improved. Every customer complaint and suggestion was noted, and a new design phase was embarked upon to overcome the perceived difficulties.

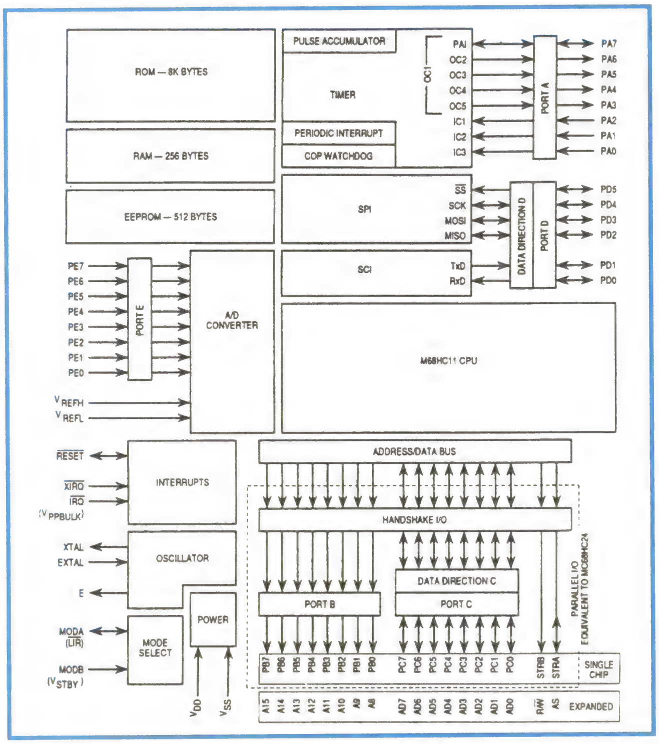


*Fig.1: The internal architecture of Motorola's M68HC11 microcontroller chip, as used in Injec's ECU.*

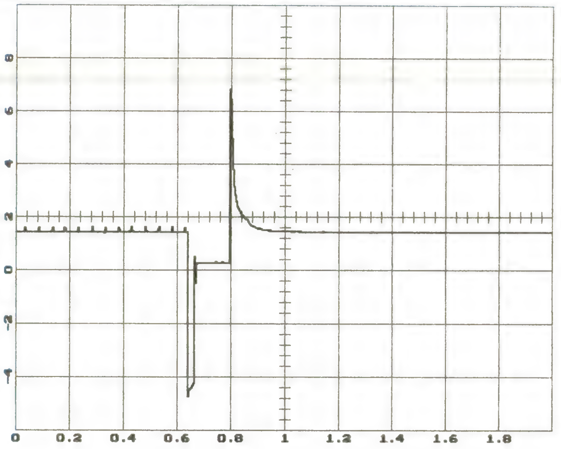
### Move to digital

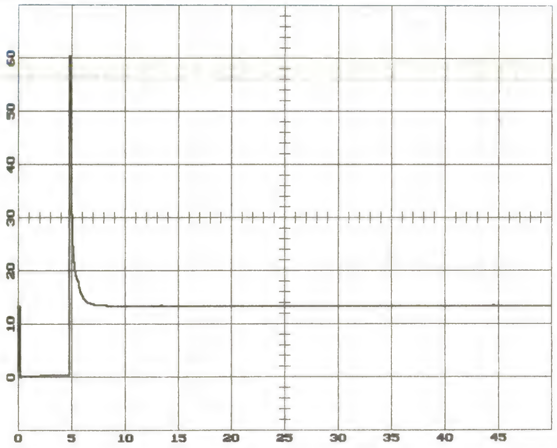
Model number two has been based around the Motorola HC11 microcontroller, a remarkable device which has an internal eight channel A/D converter, 8KB of ROM, 512 bytes of electrically erasable programmable ROM (EEPROM), 256 bytes of RAM, five analog 0-5V inputs, four pulse-width-modulated outputs (two for injectors and two for ancillaries), and eight digital inputs which can be multiplexed. An 8MHz crystal provides the appropriate timing 'ticks', and in the enhanced version, a second HC11 is employed to drive the optional display.

I have included a block diagram of the HC11 for those who might wish to have a more complete idea of its architecture. (Fig.1)

In the interview for this story, director Phil Lamovie waxed lyrical about the advantages of 'going digital'. Injec Racing found themselves becoming software engineers more than hardware. Once the basic design was complete, it was then down to software to provide the interface between man and machine.

The power of digital technology can be demonstrated by features such as plain English fault codes — modern motor vehicle manufacturers take note! A buzzer sounds, and the display might read 'Warning: water temp sender open circuit'.





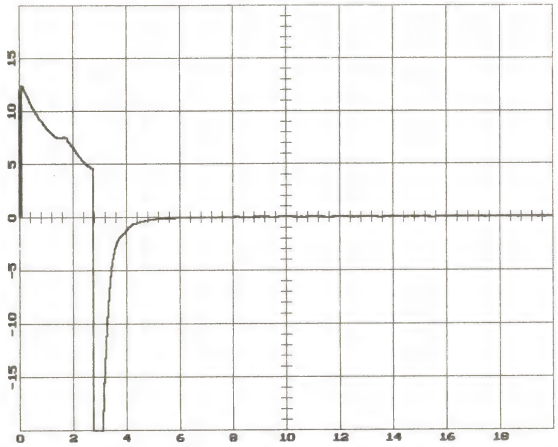
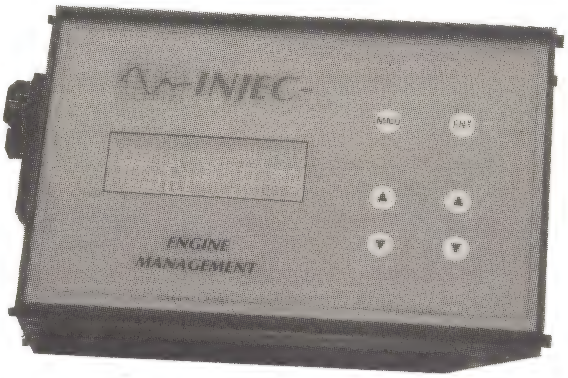


***Fig.2 (above): The injector solenoid signal wave shape delivered by the Injec ECU. Note that a 10X probe was in use, so the narrow negative going spike reaches about -50V.***

***Fig.3: (upper right): For comparison here is the injector signal wave shape delivered by a standard 'L' Jetronic ECU, which as you can see is much longer (5ms compared with less than 0.2ms.***

***Fig.4: (lower right): The wave shape from an earlier 'D' Jetronic system, again for comparison. All three wave forms were taken at idle.***



***The Injec Engine Management System console has a four-line LCD display and only six control buttons.***

How hard can it be? No more crouching under dashboards, bridging terminals, counting flashing lights, followed by cross referencing the manufacturer's handbook!

Prompts appear during the system setup routine, which question mistakes by the operator. For example if the change in injector pulse width between two rpm bands is set too large, it is questioned; and the same goes for the advance curve, cranking, cold running enrichment, acceleration enrichment, etc. And with resolution as fine as 62.7 microseconds (0.0627ms), locking in the optimum fuel setting for each load and speed range can be accurately achieved.

According to Phil, future options could include, among other things, a connection to the car alarm and car phone that will enable a recorded message to be put through to the police: "I am being stolen, my registration number is XXX-YYY... Help!" Gee, maybe they could use the global positioning system as well, to report on the car's exact location!

I can just imagine the look on the car thief's face now. One minute he's making off with someone else's pride and joy, and the next, the long arm of the law comes crashing down on his head. (Why am I assuming the thief is a he?)

Various adjustable parameters are available, such as number of cylinders (1-12 or rotary); number of injectors (1-16); turbo charged or normally aspirated; injector cut-off point in response to high vacuum on deceleration; acceleration enrichment for fast throttle openings; enrichment for cold engine conditions; cranking enrichment; cut-in temperature for cooling fan; auxillary injector control for turbo boost; rev. limiting; air conditioner cut-out under hard acceleration and warning lights for such things as overheating, etc.

For the installation centre that foresees fitting more than one unit, a more cost-effective installation can be done by using the basic 'blind' version — i.e., with no display screen.

The technician simply plugs in his own remote screen for setting up, fine tuning and servicing, and when complete, tucks the controller back under the dashboard or similar hiding place. This is probably good insurance against car owners upsetting the setting!

## Vimy 19/94 project

The 75th anniversary of intercontinental flight was celebrated last year with a re-enactment of the first flights. In 1919, British war hero John Alcock and American war hero, Arthur Whitten-Brown were the first pilots to successfully cross the Atlantic by air, and claimed their reward of £10,000.

Later in 1919, in response to

an identical reward offered by the Australian government, the Smith brothers, Ross and Keith (probably the most highly decorated pilots in Australia) and two mechanics, Wally Shiers and Jim Bennett, set off from the UK for the 11,250 mile flight to Australia.

The 1994 re-enactment of those first flights involved a massive coalition of expertise and resources, with plans of the original Vickers Vimy aircraft unearthed at British Aerospace, progeny of the original Vickers company.

The Vimy flown by the Smiths was fitted with two of the notoriously unreliable Rolls-Royce Eagle engines. However the new Vimy was fitted with two 454 cubic inch Chevrolet engines, in an effort to achieve reliability.

There being no standard 'off the shelf' engine management system for this kind of 'Chev car engines in an aircraft' application, the project engineers cast around for a comprehensive and reliable system to keep them in the air. Phil Lamovie spotted an advertisement in the paper, and handing it to fellow director Martin Williams, they set in train the necessaries to win the contract.

Four Injec EM1 models were duly installed, and the results were better than anyone anticipated. The Chev engines, rated at 420hp at a propeller speed of 3800rpm, were suddenly able to spin the props at much higher speed — indicating 530hp!

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TEL: (03) 828 2827
FAX: (03) 431 1888

Diamond Valley Engineering Consultants

READER INFO NO. 10

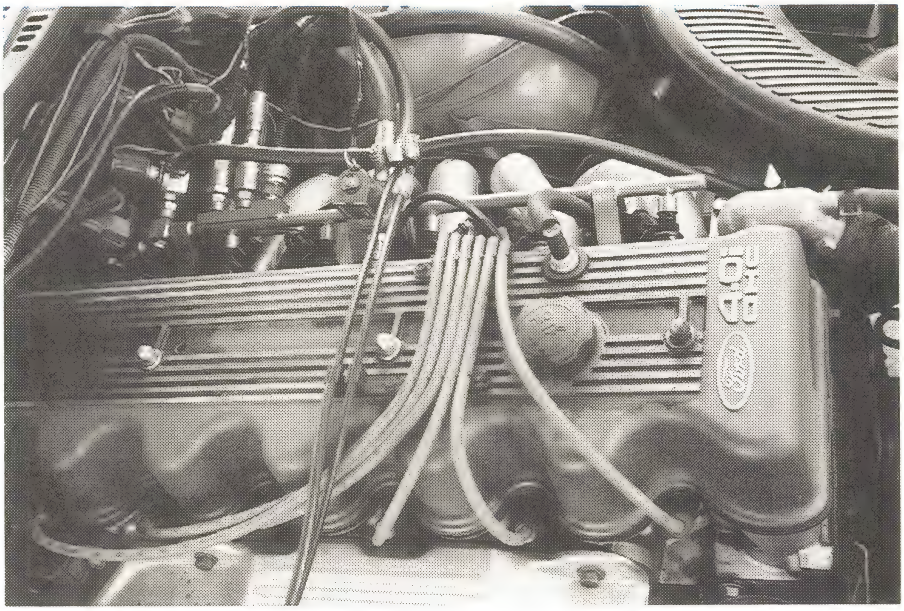

*Fig.5: An under-bonnet view of the Ford test car showing the valving and high pressure gas lines to the fuel rail.*

## Liquid phase injection

Another success for Injec has been their involvement with Adelaide company Liquiphase, who were responsible for the introduction of a liquid petroleum gas injection system late last year. This dispenses with the need to turn the LPG from liquid to gas.

Having completed the mechanical side of their invention to perfection, Liquiphase found themselves in difficulties with the engine management side.

Operating with fuel rail pressures of 350psi (instead of the usual 35-45psi for petrol), regular fuel injection computers simply could not supply the oomph required to open the injectors!

Injec Racing came to the rescue with a modified version of the EM1 controller, fitted with a transformer to increase the power of the injector driver stage. Within three days of taking delivery of the test car, Phil had programmed the Ford EA 4.0 litre engine to a well-behaved streetable level.

Fig.2 is a printout from my Auto-Diagnostics ADS9000 Tunescope of the injector waveshape at an idle condition, while Fig.3 is a standard 'L' Jetronic signal and Fig.4 is the earlier 'D' Jetronic system's waveshape, both again at idle. Fig.5 is an under-bonnet view of the test car, showing the valving and high pressure gas lines to the fuel rail.

During the obligatory road test, I was impressed with both the extra power and smoothness of the engine running on LPG. One of the most significant advantages is the changeover point from petrol to LPG, and vice-versa, as there is no requirement to use up all the petrol in the rail before switching to LPG.

Due to the valving arrangement, the changeover point is almost imperceptable from the driver's seat, even to the trained ear. So precise is the control of the EM1 management program that the operation is virtually identical to that of a standard EFI vehicle.

LPG conversions using gas 'carburettors' have been available now for decades, and recent legislation by some state governments has tried to ensure clean emissions and safe installations.

The simplicity of the Liquiphase installation, because it doesn't need a mixer or pressure regulator connected to the vehicle cooling system, will appeal to installers and customers alike.

I found the fully automatic aspect of the operation a bliss, especially as there is no need to mess with the fussy GAS/OFF/PETROL switch usually mounted on the dashboard. I also liked the lack of clutter in an already crowded engine bay.

Well, that's all from me this month. Next issue I hope to be reviewing 'hand held' automotive test gear, purpose built or specially modified for automotive use. Stay tuned! ❖

LAST CHANCE TO WIN TRACKER FOR WINDOWS!
your computer
NOVEMBER 1994
$4.95*
NDD
AUSTRALIAN PUBLICATION
HELPING PC USERS SINCE 1981
NETWORKS MADE SIMPLE
Cut through the cable confusion!
Reviewed: Coactive Connector LANsmart PowerLAN
LOTUS NOTES: Teamwork software
ALONE AT HOME: Contact Management
EDUCATIONAL SOFTWARE: Use your imagination
FREE! DISK OFFER: cALMER Utilities for DOS

*Your Computer* is Australia's only computer magazine written for small business and home users.

Our editorial is locally written and is slanted with a 'hands on' approach for those who believe in PCs as a tool to increase business efficiency and productivity. As it says on our cover we've been Helping PC users since 1981.

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NOW ON SALE AT YOUR NEWSAGENT

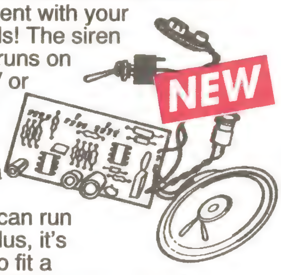
# DICK SMITH ELECTRONICS

Please contact your nearest store for availability as some kits may still be in production.

# Do-It-Yourself With Our Latest Kits!

## TRY OUR NEW DISCOVERY SERIES - all PCBs come solder-masked and with silk-screened component overlays.

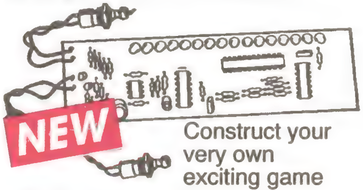
### Siren Generator



Create four different siren sounds or experiment with your own sounds! The siren generator runs on either a 6V or 9V battery (not supplied) and, with a simple change, it can run on 12V. Plus, it's designed to fit a Dick Smith Electronics zippy box (optional) for a professional finish. Fun and easy to build, it comes complete with all components, PCB & hardware such as switches, battery-snap & speaker.

Cat K-2801 **$16.95**

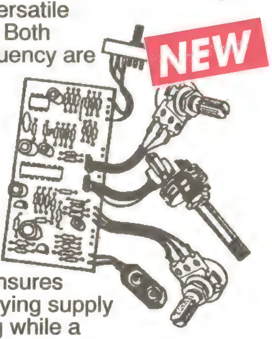
### Flash, Dash Or Crash!



Construct your very own exciting game of patience, co-ordination and skill. Featuring 16 LEDs which operate in sequence, the game requires you to 'climb' the ladder of LEDs by pushing a button. Sound easy? Well, wait until you try it! It has auto power cut-off and is powered by 4 x AA batteries (not supplied). Comes in short form with all components plus solder-masked & silk-screened PCB. Designed to fit into optional Dick Smith Electronics zippy box ( H-2851).

Cat K-2800 **$19.95**

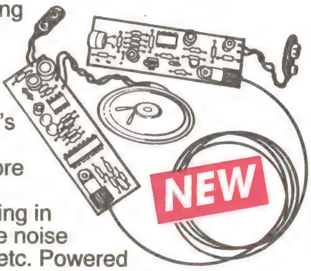
### Function Generator Kit



The affordable and fun way to build a very useful and highly versatile function generator! Both amplitude and frequency are voltage controlled so you can even combine two of these to make an audio sweep generator or amplitude modulated audio generator! Its voltage regulator ensures stability against varying supply voltage and loading while a trimming facility is provided for frequency alignment when a calibrated dial is used. Powered from a single 9V battery (not supplied) or any DC supply between 8.5V and 15V. Comes in short form with all components, PCB & hardware such as pots and switches.

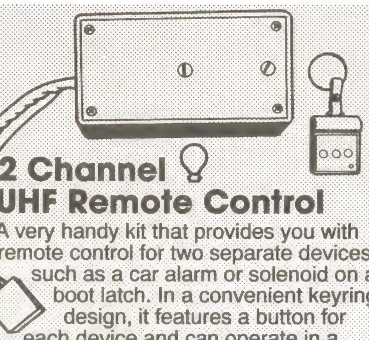
Cat K-2802 **$16.95**

### Fibre Optic Audio Link



Given the ability of fibre optics to deliver interference-free sound at the speed of light, it's fast taking over copper wire as the new standard for communications technology. Now's your chance to learn all about fibre optics! This kit is perfect for installing in devices that have noise problems, static etc. Powered by two 9V batteries, it makes a significant difference to sound quality, allowing you to listen to interference-free transmissions. Comes in short form with a length of optic fibre cable, a pair of transmitter and receiver devices, electret microphone and all components.

Cat K-2803 **$49.95**



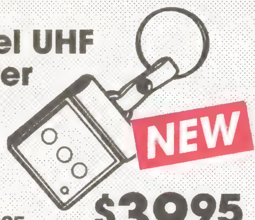
### 2 Channel UHF Remote Control

A very handy kit that provides you with remote control for two separate devices such as a car alarm or solenoid on a boot latch. In a convenient keyring design, it features a button for each device and can operate in a range of up to approx. 20 metres with a 30cm antenna. Plus, it allows for 6561 security code options and is DC powered (between 10 & 15 volts). The receiver is a small module that uses surface mount components, is tuned to 304MHz and is supplied already aligned and tested. Kit will be supplied complete with all components, PCB receiver module, case, and one 2 channel transmitter (fully assembled).

Cat K-3260 **$99.95**

SILICON CHIP Jan '95

### 2 Channel UHF Transmitter

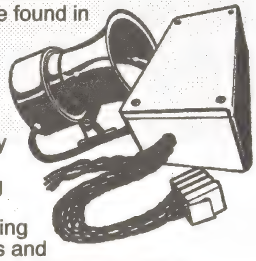


Additional transmitters to suit K-3260.

Cat K-3261 **$39.95**

SILICON CHIP Jan '95

### Car Alarm With Battery Back-Up



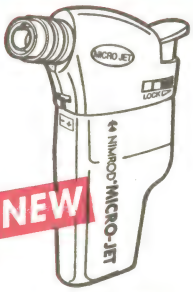
This affordable kit places a quality feature-packed car alarm well within your reach. Based on the OM1681C Philips car alarm IC, it's straightforward to build yet it provides similar features to those found in commercially available units. Such features include battery back up, presettable entry & exit delay periods, flashing status LED, automatic resetting after 60 seconds and the ability to automatically operate a central door locking system with optional interface controller (K-4314) & UHF remote switch (K-3260). Includes all components, PCB, hardware including automotive multiway connector, case & siren with back-up battery.

Cat K-4312 **$89.95**

SILICON CHIP Dec '94

# We Have All The Electronics You Need!

## Microjet Butane Torch



NEW

A pocket-sized blow torch that's very cheap to run - just clip in a normal cigarette lighter! With easy auto-ignition, it heats up to 1300°C in an instant. Complete with cigarette lighter.
Cat T-1366

**$29.95**

NEW

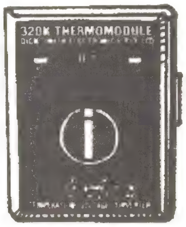
## Lighter Refill To Suit Microjet Torch

**95¢**

Cat T-1363

## Temperature To Voltage Converter

Incredibly handy for labs, air conditioner service people or for anyone who works with heat or heat exchange. It's used in conjunction with a multimeter and requires a 9V battery. Complete with bead type thermocouple (maximum insulation temperature 260°) on a 1.2m lead with K-type connector.



***Range:***

**Thermocouple:** -40°C to 260°

**Unit:** -50°C to 1300°C

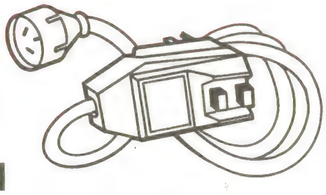
Cat Q-1430

Was $69.95

**$49.95**

NEW

## Safety Switch & Cord



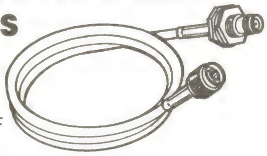
Attach this to your drill, electrical garden tools etc for protection from power faults. It prevents electrocution by cutting off your power before a fault does any damage and ensures the power stays off until you press the restart button. A blue button indicates when the unit has tripped on an earth fault. With 1.6-metre lead.
Cat M-7294

HPM

**$44.95**

Was $149.95 In '94 Catalogue!

## Box Of 20 High-Quality Assorted Coax Cable Assemblies



***Set includes:***

**BNC plug to:** BNC plug, PL259 plug, BNC socket, Mini UHF plug, IC test clips, 'N' connector plug & TNC plug

**PL 259 plug to:** PL259 plug, TNC plug, Mini UHF plug & 'N' connector plug

**'N' connector plug to:** 'N' connector plug, Mini UHF socket, Mini UHF plug & TNC plug

**Mini UHF plug to:** Mini UHF plug & TNC plug

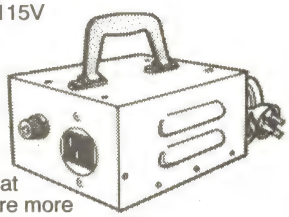
**TNC plug to:** TNC plug, Mini UHF socket & TNC socket.

Cat Q-1936

**$99.95**

HURRY! Limited Stocks!

## 240V-115V 65VA Transformer



High-quality 115V step-down transformer perfect for audio, computer, laboratory or any other equipment that doesn't require more than 65-watt (0.57A) capacity. Comes complete with convenient carry-handle and non-slip feet.
Cat M-1151

**$99**

## 240-115V 250VA Transformer

For more heavy-duty applications, this transformer has 2.17A (250W) capacity. It's particularly suitable for personal computers, small sound systems and other appliances that require higher power. Includes carry handle and non-slip feet. Cat M-1152

**$169**

*Also available at selected stores and on order:*

## 240V - 115V 500VA Transformer

Cat M-1153

NEW

**$249**

## 240V - 115V 1000VA Transformer

Cat M-1154

NEW

**$379**

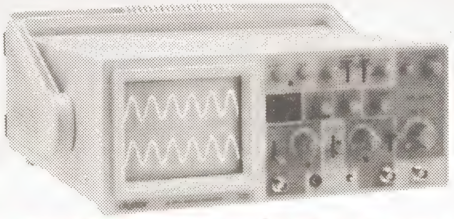
# Dual Trace, Dual Trigger 20 MHz CRO

An affordable 20MHz oscilloscope that's suitable for a wide range of applications. It's a dual trace, dual trigger CRO with a fully adjustable sweep time (in 20 steps), variable hold-off, fully adjustable sensitivity, switch selectable X-Y operation, selectable trigger modes, AC/TV H/TV V trigger coupling, front-panel variable trace rotation and a sweep rate from 10nS/DIV to 1S/DIV.

***Specifications:***

| | |
|---|---|
| Vertical Sensitivity: | 5 mV/div to 5 V/div (x1 mode)<br>1 mV/div to 1 V/div (x5 mode)<br>1-2-5 sequence, 10 step attenuator. |
| Sweep Speed: | 0.1 uS/Div to 0.2 S/Div in 1-2-5 sequence, 20 steps |
| Sweep Magnification: | 10X |
| Rise Time: | Approximately 17.5ns |
| Operating Modes: | Ch1, Ch2, Alt, Chop, Add |
| Trigger Coupling: | AC, TV-H, TV-V |
| Trigger Sensitivity - | |
| Internal: | 0.5 division (1 division with TV coupling) |
| External: | 500mV |
| Trigger Source: | Ch1, Ch2, Alt, Ext, Line. |

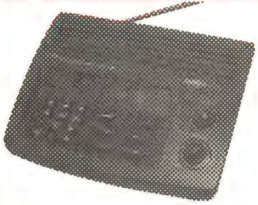
Cat Q-1802



INCLUDES A PAIR OF PROBES!

**$729**

# The Very Best In Radio Technology From uniden.



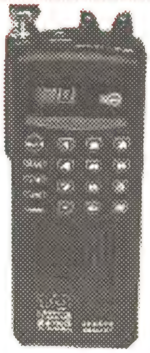
NEW

## Bearcat UBC144XLT Scanner

The new Uniden 144XLT 8 band scanner offers wide frequency coverage, yet is extremely easy to operate. With 16 programmable channels and 66-88, 137-174 and 406-512MHz coverage, it's great for listening to known VHF/UHF services. Through the use of a straightforward 2-digit LED display you can easily check what frequency is entered into each channel, and a specific frequency can be given Priority status where necessary. Supplied complete with AC adaptor and telescopic antenna.

uniden.

Cat D-2744 **$149.95**



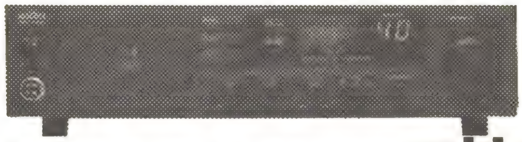
## 60XLT Scanner

New, simple-to-use 10-channel scanning receiver for listening to known VHF/UHF services. Covers 66-88, 137-174, and 406-512MHz. Also great for listening to ethnic language services that don't operate on the FM broadcast band.

Cat D-2746

uniden.

**$169.95** NEW



## Uniden Pro 810e Base Station AM/SSB CB

uniden.

With a large front-mounted speaker that gives superb sound, front-mounted microphone jack, well spaced controls, large illuminated received Signal/RF meter and easy-to-read LED channel display. Has an inbuilt AC power supply and is SMA approved.

Cat D-1485 **$299**

NOW AVAILABLE

uniden.

## Uniden 120XLT Scanner

The new Twin Turbo 120XLT hand-held scanning receiver provides nine-band VHF/UHF coverage including airband, 100 memories, and improved super fast scan and search features (scan up to 100 channels/sec, search at 100 or 300 steps/sec). Covers 66-88MHz, 108-174MHz, and 406-512MHz. Also features 10 priority channels, data skip and memory back-up. Complete with NiCad battery pack, AC charger and detailed instructions.

Cat D-2752

*not illustrated*

NEW **$369**

### THOMSON Mains Suppressor Capacitors

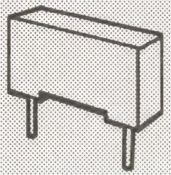
## DX Series, X2 Class

NEW

| | | | |
|---|---|---|---|
| 0.01 uF | 275VAC | Cat R-2620 | **$1.35** |
| 0.022uF | 275VAC | Cat R-2622 | **$1.45** |
| 0.033uF | 275VAC | Cat R-2624 | **$1.55** |
| 0.047uF | 275VAC | Cat R-2626 | **$1.65** |
| 0.1 uF | 275VAC | Cat R-2628 | **$1.95** |
| 0.22uF | 275VAC | Cat R-2630 | **$2.15** |
| 0.33uF | 275VAC | Cat R-2632 | **$2.55** |
| 0.47uF | 275VAC | Cat R-2634 | **$2.95** |

## Y-Class Mains Suppressor

Cat R-2640



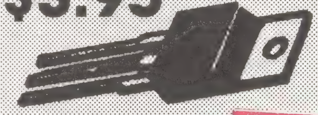
**$3.95**

NEW

## MTP3055E N-Channel T-MOS

Cat Z-2132

**$3.95**



NEW

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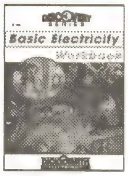
**MAJOR DICK SMITH ELECTRONICS AUTHORISED STOCKISTS:**

**NSW ARMIDALE:** New England Electronics 711 655 **BALLINA:** Ballina Electronics 867 022 **BATEMAN'S BAY:** Baycity Sight & Sound 725 030 **BATHURST:** Electronic Frontiers 323 933 **BOURKE:** Countrywide Services 722 150 **BOWRAL:** Bowral Electrical Suppliers 611 861 **BROKEN HILL:** Hobbies & Electronics 884 098 **COOTAMUNDRA:** Cootamundra Music & Light 422 561 **DENILIQUIN:** Deni Electronics 813 672 **DUBBO:** Chris's Hi Fi 828 711 **GOULBURN:** Tunlive 221 288 **GRAFTON:** Repairs & Spares 421 911 **GRIFFITH:** Miatronics 624 534 **GUNNEDAH:** Carter's Sportscene & Electronics 42 2230 **INVERELL:** Infolink Computer Systems 22 1821 **KEMPSEY:** P & K Richards 631 134 **LEETON:** Leeton Audiotronic 532 800 **LIGHTNING RIDGE:** Lightning Ridge Solar Power 291 013 **LISMORE:** Decro Electronic Services 214 137 **LITHGOW:** Douroy Photographics 513 173 **MACKSVILLE:** Macksville Electronics 683 368 **MOREE:** Moree Electronics 522 091 **MUDGEE:** Headwear 723 895 **MURWILLUMBAH:** Strings & Things 723 684 **NARRABRI:** Namoi Computer Service 923 274 **NELSON BAY:** Nelson Bay Elect. & Hobbies 813 685 **NOWRA:** Nowra Electronics 210 722 **PARKES:** Strad Music Centre 623 366 **PORT MACQUARIE:** Port Electronics 841 594 **RICHMOND:** Silicon Crafts 784 101 **TAREE:** Manning Electronics 512 233 **TUNCURRY:** Tuncurry Electronics 545 006 **WAGGA WAGGA:** Phillips Electronics 216 558 **WALGETT:** Walgett Electronic Centre 281 111 **WINDSOR:** Hawkesbury Electronics 776 722 **YASS:** Warmington Electrical 226 1411 **YOUNG:** Keith Donges 821 279 **VIC ARARAT**: Jerram Electronics 522 345 **BAIRNSDALE:** Green Gage Services 525 677 **BENALLA:** North East Electronics 622 710 **CASTLEMAINE:** Inspect Electrics 723 773 **COLAC:** Colac Electronics 312 847 **ECHUCA:** Gilmour Electronics 822 956 **HORSHAM:** Burgess Camera House 824 680 LEONGATHA: Leongatha Photographics 623 227 **MILDURA:** Pullman Auto Pro 232 882 **MORWELL:** Roylaine Pty Ltd 339 458 **ROSEBUD:** Seatech Vic Pty Ltd 822 225 **SHEPPARTON:** Andrew Guyatt Electronics 219 497 **SWAN HILL**: Nyah District TV Service 329 303 **ST. ARNAUD:** Whartons Appliances 951 069 **WARRAGUL:** Roylaine 234 255 **WARRNAMBOOL:** Koroit St. Elect. Services 627 417 **WONTHAGGI:** South Gippsland Photo Service 721 411 **QLD AYR:** Delta Electrix 831 566 **BOWEN:** Plaza Electronics 863 477 **BUNDABERG:** Bob Elkin Electronics 521 785 **CALOUNDRA:** Electro-mart 918 533 **DALBY:** Hobby & Electronics 625 770 **GOONDIWINDI:** CTW Electronics 713 411 **GYMPIE:** Cooloola Electronics Pty Ltd 83 6677 **INGHAM:** Masons Electronics 763 188 **INNISFAIL:** Innisfail Hi-Fi 612 014 **MACKAY:** Steven's Electronics 511 723 **MARYBOROUGH:** Keller Electronics 214 559 **MOSSMAN:** Mossman Electronics 982 200 **MT. ISA:** Outback Electronics 433 475 **PIALBA:** Keller Electronics 283 749 **STANTHORPE:** Granite Belt Communications 813 333 **TAS BURNIE:** Electronic City 314 760 **DEVONPORT:** Al Electronics 248 322 **SA MT. GAMBIER:** Hutchesson's Communication 250 400 **PORT LINCOLN:** Basshams TV & Comp. World 830 075 **WHYALLA:** Eyre Electronics 454 764 **WA ALBANY:** Micro Electronics 412 077 **BUNBURY:** Micro Electronics 216 222 **GERALDTON:** Angora Lighting 211 278 **MANDURAH:** Mandurah Hi FI 581 2206 **MARGARET RIVER:** CPA Electronics 573 888 **PORT HEDLAND:** Ivan Tomek Electronics - Retail 732 531

# Up-Date Your Library With Our New Books!



## Dick Smith Electronics Basic Electricity Workbook

NEW

Written in conjunction with the Basic Electricity video, it goes into greater depth and answers many questions you may have about electricity.

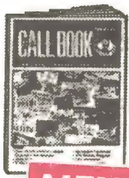
Cat B-1400 $7.95

## Dick Smith Electronics Basic Electricity Video

A great introduction to electricity, this video presents the basic principles behind electricity in an entertaining and informative way. With the help of simple diagrams and clear examples, it teaches you about: The nature of electrical charge, Atomic structure, Conductors Vs Insulators, Energy & Power, AC & DC, and formulas relating Volts, Amperes and Watts. Running time: Approx 13 minutes.

NEW

Cat B-1402 $26.95



## WIA Australian Call Book 1995

Complete, up-to-the-minute listing with valuable information about all members listed on the Wireless Institute of Australia

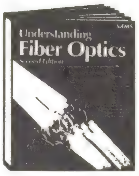
NEW

Cat B-2337 $12.50

## Passport To Worldband Radio 1995

Imperative for anyone getting started with a shortwave radio, this up-dated 1995 edition includes what's on shortwave radio, how to get the most from your shortwave listening and more!

Cat B-2055 $34.95



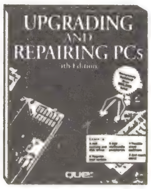
## Understanding Fiber Optics

NEW

You've built the kit - now read the book! Explore everything there is to know about fibre optics and its potential role in the future of communications technology. 'Understanding Fibre Optics' contains 477 pages, providing detailed information the fibres themselves, tools used, and applications for fibre optic cabling.

Cat B-1310 $55.95

**Fourth Edition**

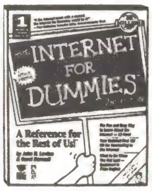


## Upgrading And Repairing PCs

NEW

Learn how to upgrade and repair your PC yourself and you'll save a packet on maintenance! A great reference offering trouble-shooting tips, advice on preventative maintenance, solutions to common PC problems and more.

Cat B-6188 $74.95



## Internet For Dummies

Satisfy your curiosity about the Internet - cruise onto the Information Super Highway' yourself. This easy-to-understand book is your ticket!

NEW

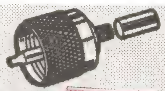
Cat B-6626 $34.95

**6V DC 900mA - 12V DC 1.8A Solenoid**

**Due end of January 95**

Cat P-9010 $18.95 NEW

**UHF Line - Plug, Crimp Type to suit RG59**

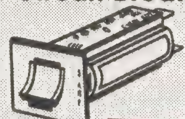


NEW

Cat P-2313 $3

**240V 15A Mini Circuit Breaker**

**Potter & Brumfield (U.S.A)**



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B 1840

## Construction Project:

# NEW STEREO TV SOUND RECEIVER - 1

Would you like to get full stereo reproduction from your local TV stations, but can't afford to junk your trusty mono telly and buy one of the fancy new stereo models? Here's a practical and much lower cost alternative: a separate TV sound receiver, which hooks up to your hifi system to provide high quality stereo sound. It even includes a simple but quite effective 'surround sound' decoder with filtered subwoofer outputs, as a bonus...

### by JIM ROWE

Most Australian TV stations have been transmitting stereo sound for some years now, using the German 'Zweiton' dual-subcarrier system. As a result, those fortunate people who have been able to afford one of the up-market receivers with an inbuilt stereo decoder can enjoy the added realism and aural imaging delivered by stereo sound.

Many people *haven't* been able to take advantage of the stereo transmissions, though, because of the relatively high cost of stereo sets. If you have an otherwise perfectly OK mono set, it often isn't easy to justify replacing it, purely in order to get stereo sound...

Of course there *is* a way to keep your old set, and still get the benefits of stereo sound — at relatively low cost. This is by building a separate receiver for the stereo sound signals, and connecting it up to your existing hifi system. Then your TV still provides the pictures, while your hifi speakers provide the improved stereo sound.

As it happens, we described a Stereo TV Sound Receiver of this type back in the March and April 1985 issues. That project was designed by the R&D department at Dick Smith Electronics, and clearly met a widespread need — because DSE sold large numbers of corresponding kits. As time passed, though, the design gradually became obsolete as quite a few of the special components it used were discontinued by their manufacturers. So despite a continuing demand for this kind of receiver, the kits ultimately had to be discontinued as well.

Since then, though, both we and DSE have been getting a steady stream of requests to produce an updated version. And finally we've been able to do this, with some much appreciated help from DSE in sourcing some of the key components. So here it is — the new Stereo TV Sound Receiver Mk2.

It's in the same sized case as before, although we've been able to simplify down the internals quite a bit, thanks to the use of more modern ICs. It still provides for a total of six preset- tuning VHF or UHF channels, but the front panel is simpler and cleaner than before because we've moved the preset tuning controls to the rear panel (and also used standard 10-turn trimpots, for lower cost and fewer supply problems).

Unlike the old model, this version *doesn't* include a small inbuilt audio power amplifier. We decided to leave this out, because most people nowadays have a stereo hifi amplifier which can generally provide better reproduction anyway.

Instead, though, we've included the circuitry for a simple 'surround sound' decoder, with outputs not only for the normal 'front left' and 'front right' stereo channels, but also for 'front centre' and 'rear ambience' channel signals. There's even a pair of pre-filtered subwoofer channel outputs, to drive a subwoofer in bridge mode via a spare stereo amp. So for those who want to use the receiver as the basis for a 'home TV theatre' setup, all that's needed is some additional audio amplifier channels.

Like the earlier unit, the new receiver provides a composite video output to allow its channel selector to become the 'master' tuning control for your stereo TV reception, if you wish. However in this case we *haven't* provided a modulated-RF video output, for two reasons. One is that most people now have either a TV with at least one composite video input, or else a VCR which provides the same facility.

The other reason for not including an RF modulator is that in our opinion, most of these modules do not deliver high enough performance. In any case, there is inevitable picture degradation when the video is passed through a second cycle of modulation and demodulation. Since this receiver is specifically designed to deliver *enhanced* audio performance, we don't see the sense in accompanying this with *degraded* video.

Of course, you don't have to use the video output of the Stereo Sound Receiver at all — you can simply use your TV's own picture. You'll just have to adjust both channel selectors, in order to get matching picture and sound when you change channels.

Incidentally, Rob Evans' new low-cost 'Shoestring Stereo Amplifier', described last month, would make an ideal companion to our new receiver — either for the basic stereo channels, if you *don't* have an existing hifi, or for the additional surround sound or subwoofer channels if you *do* have one, but it only has two channels. It delivers a very clean 15W per channel, more than enough for this kind of application...

Before continuing, I should note here that since New Zealand uses a different stereo sound system for its TV (the Nicam system), this sound receiver won't be of any use to our NZ readers — only those in Australia. Sorry!

## Zweiton stereo

At this point, perhaps I should also provide a brief recap on the stereo sound system used by Australian TV stations. The original mono sound system used a single sound carrier 5.5MHz higher than the vision carrier, you may recall. When the system was changed to stereo in the

early 1980's using the Zweiton system, a second sound carrier was added 242kHz higher again — i.e., 5.742MHz higher than the vision carrier. Often the two sound carriers are visualised as 'subcarriers' at 5.5MHz and 5.742MHz respectively, and in fact 'dual subcarrier system' is an alternative name.

The resulting pair of sound carriers is frequency modulated with the stereo sound information. However they are not simply used to carry the 'left' and 'right' channels respectively, as you might expect, because this would not have maintained compatibility with existing mono receivers. Instead, the original 5.5MHz subcarrier is used to convey the 'sum' of the two stereo signals — i.e., an 'R+L' signal, which of course corresponds to a mono version of the stereo program. This is the part of the signal demodulated by a mono receiver, for normal mono reception.

The second 5.742MHz subcarrier carries a '2R' signal, or the signal from the 'right' stereo channel only, with a level nominally the same as the sum signal (to optimise signal-to-noise ratio). This allows a stereo receiver to reproduce the two original stereo channels, by using the 2R and L+R signals in a vector subtraction or 'dematrixing' process, to restore the original 2L signal.

All this means is that the 2R signal is subtracted from (i.e., added to, but with reverse polarity) the R+L signal, after the latter is amplified by a factor of two — to produce a 2L signal:

$2(R+L) - 2R = 2L$

As the Zweiton system allows a TV station to transmit sound in standard mono, stereo or even with two different mono signals on the two subcarriers (for bi-lingual programmes), the second sound carrier *also* carries a 'pilot subcarrier' of 54.6875kHz. This is amplitude modulated with low-level audio tones, to indicate to the receiver which type of sound is being transmitted. No pilot modulation at all means mono transmission; modulation with 117.5Hz means stereo; while modulation with 274.1Hz means bi-lingual transmission.

A stereo receiver can decode these pilot subcarrier signals to automatically switch sound modes. But in Australia this is not really necessary, as most TV stations seem to be either transmitting in stereo continuously, or have not converted to stereo and are hence not transmitting the 5.742MHz second subcarrier at all...

## Quasi-split sound

Like the earlier receiver, our new design uses the so-called 'quasi-split sound' receiving technique, to deliver improved sound quality in comparison with the conventional 'intercarrier' system.

You may recall that with the intercar-

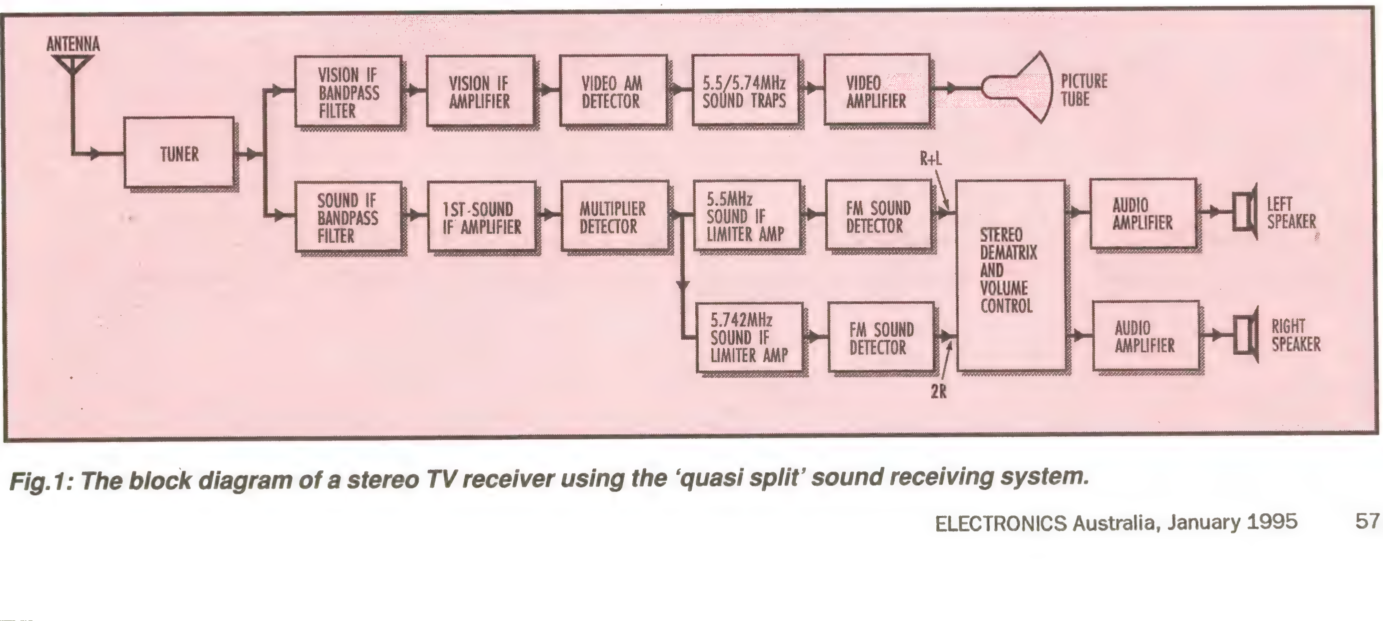
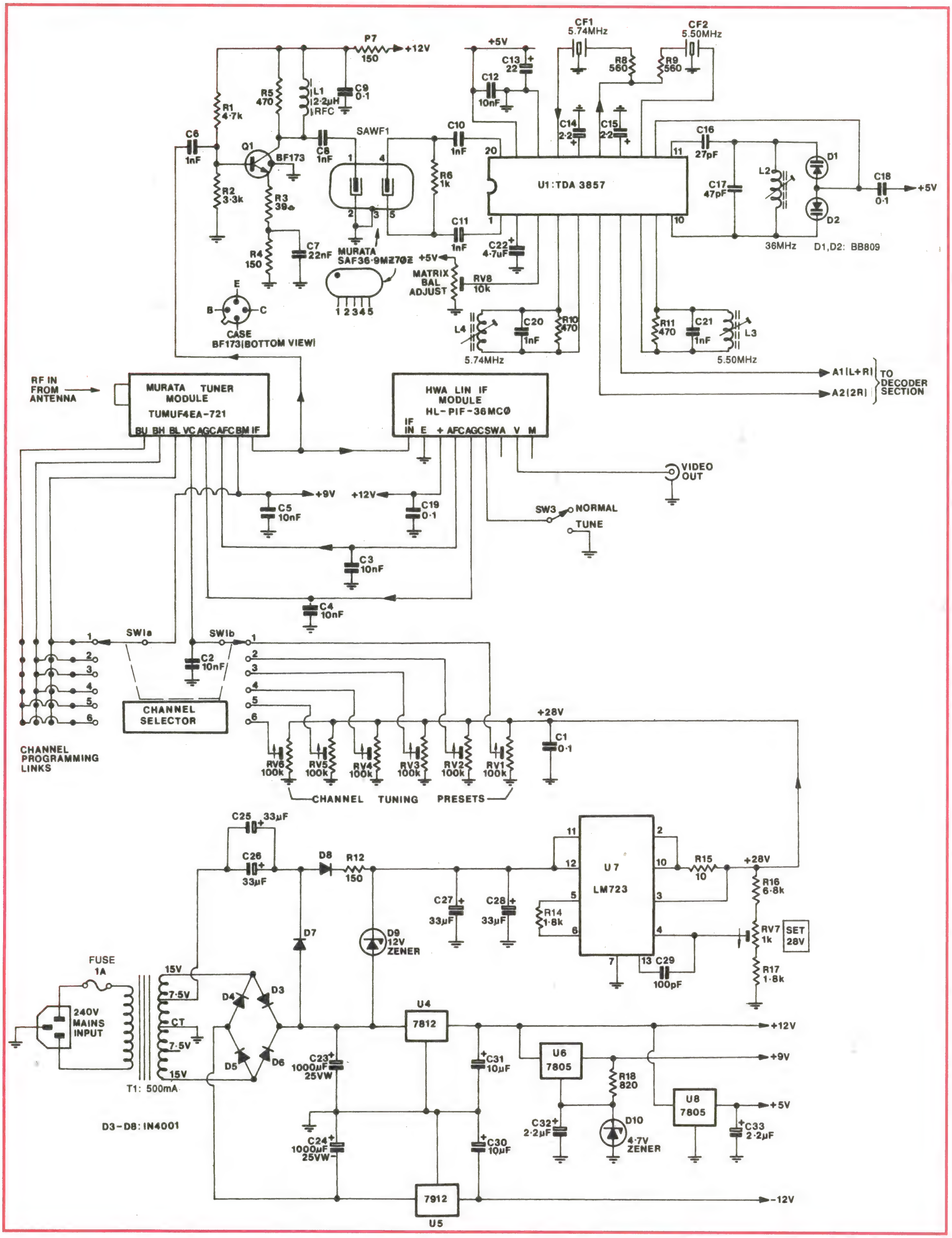


*Fig.1: The block diagram of a stereo TV receiver using the 'quasi split' sound receiving system.*

# New Stereo TV Sound Receiver - 1



rier system, the vision and sound carriers of the received signal are both fed through a common tuner and 'video IF' section, and end up at the video detector. In this detector the sound carrier beats with the vision carrier, to produce a 5.5MHz intercarrier signal which is then filtered off and passed through its own 'sound IF' section before being demodulated by the FM sound detector.

This system is economical, but it does suffer from a well-known shortcoming — the difficulty of removing frame 'buzz' and other picture-related components from the sound. It can also be difficult to optimise picture resolution, without getting 'herringbone' interference from the sound subcarrier(s).

Many modern sets avoid these problems by using the so-called *quasi-split sound* system. Here the sound and vision IF signals emerging from the tuner are passed to two separate IF strips and detector systems, one optimised for video and the other for audio (Fig.1). The 'vision IF' has its bandpass filter set to maximise picture resolution, while a deep 'trap' filter minimises the sound signal for reduced interference.

The separate 'first sound IF' still carries vision IF information as well as that for sound, but in this case only the vision carrier itself is needed, in order to be able to heterodyne the two together in a multiplier-type second detector, for generating the 5.5MHz and 5.742MHz 'second sound IF' components. Because of this, the first sound IF bandpass filter can again be optimised — here for minimum intercarrier buzz.

After the 5.5MHz and 5.742MHz second sound IF signals are produced in the multiplier detector, they are fed through their own separate bandpass filters and IF amplifiers, and finally to separate FM detectors to produce the R+L and 2R audio signals. These can then be processed in the 'stereo dematrix' to produce the final stereo (and possibly surround) signals.

## Circuit description

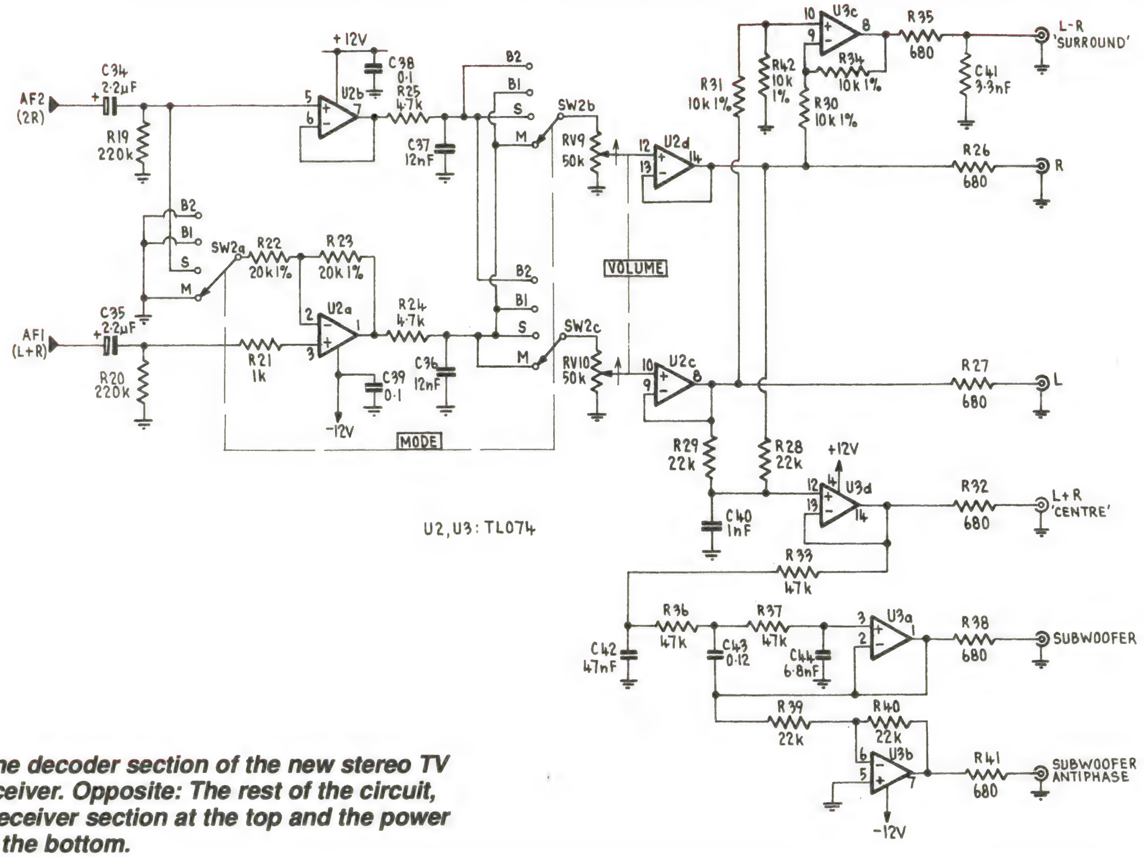
Having looked at both the Zweiton stereo sound system and the basic technique of quasi-split sound reception, let's now look at the circuit of the new receiver to see how it all works out in practice.

As with the earlier Stereo Sound Receiver, this design uses a pre-assembled and factory aligned tuner module to simplify construction and avoid the need for elaborate RF test equipment. The module used here is the Murata TUMUF4EA-721, which has varicap tuning and covers all Australian VHF-UHF channels. It provides a typical power gain of around 33dB and a noise figure of about 5dB, with the vision IF at 36.875MHz and the R+L sound IF at 31.375MHz.

To provide the tuner module with appropriate AGC and AFC control signals, we have also used here a pre-aligned IF/detector module, the Hwa Lin HL-PIF-36MC05. This also serves the purpose of delivering our composite video output, for driving a video monitor or feeding into the direct video input of your TV receiver (so that the Sound Receiver's channel selector works for both vision and sound). The video output is at the standard 75-ohm impedance level, by the way.

Switch SW1 is the channel selector, and provides for up to six preset channels. One pole, SW1a, is used to perform tuner bandswitching, in conjunction with a simple system of wire links on the receiver's printed circuit board. The links simply determine which of the three band-enable inputs of the tuner module is fed with +9V, for each position of the switch.

The second pole of SW1 is used to select the varicap tuning voltage for each preset channel, with the six preset voltages being derived from a +28V supply via RV1-6, which are standard 10-turn



***Above: The decoder section of the new stereo TV sound receiver. Opposite: The rest of the circuit, with the receiver section at the top and the power supply at the bottom.***

# New Stereo TV Sound Receiver - 1

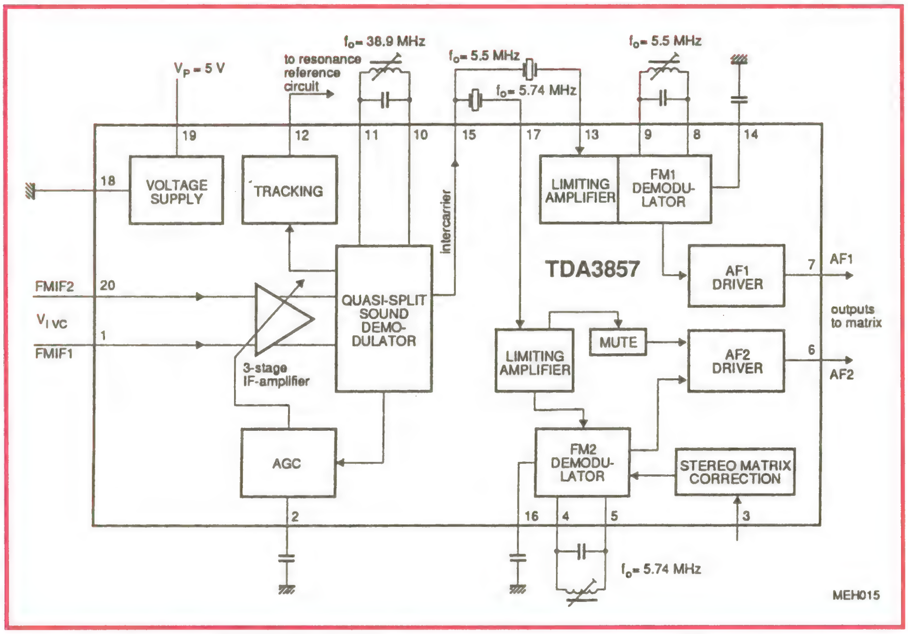


***Fig.2: The internal block diagram of the TDA3857 chip, taken from the Philips data book. It provides a full quasi split sound IF and detector system...***

preset pots mounted on the rear of the receiver's PCB.

Toggle switch SW3, also mounted on the rear of the receiver, is used to disable the AFC function when you're adjusting the tuning for each channel.

Between them, the two modules provide the receiver's main tuner and vision IF/detector sections. (Actually the Hwa Lin module also includes a mono sound section, but we're not using it here.) However the quasi-split sound section of the receiver must be provided separately, and this will now be described.

As you can see, as well as being taken to the input of the Hwa Lin module, the IF output of the tuner is also fed via C6 to the base of transistor Q1. This is used as a buffer-preamp for the first sound IF, providing a gain of about 21dB (12 times) to compensate for the loss in the surface acoustic wave filter SAWF1, used to provide bandpass filtering for the first sound IF. SAWF1 is a Murata SAT36.9MZ70Z.

After amplification by Q1 and filtering by SAWF1, the sound and vision signals are fed to U1, which is a relatively new chip designed specifically for quasi-split sound processing: the Philips TDA3857. The internal 'works' of this chip are shown in Fig.2, and as you can see it includes a three-stage first IF amplifier with internal AGC, a multiplying detector (called the 'quasi-split sound demodulator') to produce the 5.5MHz and 5.742MHz sound IF signals, and two separate sound IF/FM detector sections, designed to work with external ceramic bandpass filters and quadrature detector circuits. It also includes automatic muting of the second subcarrier's audio output AF2 when the second subcarrier is not being transmitted, and also the ability to vary the output level of the AF2 audio, for balancing of the following stereo decoder matrix. In short, it's a very powerful chip, with many more functions than the chips used in the earlier receiver (which are now unavailable, in any case).

Getting back to our main circuit, the balanced 36MHz IF signals from SAWF1 are fed into U1 via C10 and C11, to pins 20 and 1. From here they are amplified, to appear at the multiplier detector tuned circuit connected across pins 10 and 11 at the other end of the IC. Inductor L2, together with C16, C17 and varicap diodes D1 and D2 (BB809) forms the detector tuned circuit, which is tuned using L2's slug for correct operation of the detector (corresponding to minimum frame buzz). The purpose of D1 and D2 is to provide a local AFC or 'tracking' action for the detector, to compensate for temperature drift; the varicaps are fed with a DC control voltage from pin 12 of the TDA3857 itself.

The 5.5MHz and 5.742MHz sound IF components emerge from the multiplier detector at pin 15 of U1, and are separated by series resistors R8 and R9 before passing to individual bandpass filters CF1 and CF2. These are both Murata 'high selectivity' ceramic filters, one being an SFT5.5MA for the R+L sound IF signal and the other an SFT5.74MA for the 2R signal. Both filters provide over 50dB of out-of-band signal rejection, for optimum signal to noise and channel crosstalk performance.

The two filtered sound IF signals are fed back into the chip via pins 13 and 17, and then pass through their separate second IF limiting amplifiers and FM quadrature detectors. Inductor L3, capacitor C21 and resistor R11 form the low-Q tuned circuit for the 5.5MHz 'A1' (L+R) detector, while L4, C20 and R10 form the 5.742MHz tuned circuit for the 'A2' (2R) detector. In both cases the tuned circuits are adjusted using the inductor slugs, for the highest audio level and minimum frame buzz.

The AF1 and AF2 audio outputs emerge from pins 7 and 6 of the TDA3857 respectively, ready for processing by the stereo dematrix. Preset pot RV8 provides an adjustable DC control voltage to pin 3 of U1, to vary the level of AF2 over a small range (about +/-1.5dB) for dematrix balancing.

The remainder of the audio processing circuitry can be seen in the second schematic. Only two TL074 quad FET input op-amps (U2 and U3) are used for all of the audio processing, including the derivation of 'surround' and 'subwoofer' signals from the basic stereo information. The AF1 and AF2 signals reach this section of the circuit after passing through coupling capacitors C34 and C35, used to remove the DC levels present at the outputs of U1.

U2a is the stereo dematrixing stage, which has the AF1/L+R signal fed to its non-inverting (+) input directly via stopper resistor R21. For this signal, the op-amp's effective voltage gain is exactly 2.0, because of the voltage divider action between feedback resistor R23 and resistor R22, in series with the *inverting* (-) input. (The gain is (R23 + R22)/R22 = 2.0.)

On the other hand, when mode switch SW2 is in the S (stereo) position, the AF2/2R signal is also fed to U2a, but in this case to its inverting input, via resistor R22. And for this signal the op-amp's effective gain is -1.0, because this time the gain is set by R23/R22 and both have the same value. The nett result of this is that in stereo mode, the output of U2a consists of 2(L+R) - 2R, or 2L — our second stereo output.

Note that the AF2/2R signal is passed through U2b, wired as a voltage follower. Although not really necessary, this stage is used largely because I had an op-amp to spare. However for the purists, it will also ensure that the 2R signal receives a propagation delay virtually identical to that added to the 2L signal, in passing through the dematrixing stage U2a...

From U2a and b, the 2L and 2R signals are fed through FM de-emphasis filters R24/C36 and R25/C37, to restore their original flat response. Then they're made available at SW2c and SW2b, to allow selection of the receiver's operating mode: mono, stereo, bi-lingual 1 (from the AF1 channel) or bi-lingual 2 (from the AF2 channel).

Note that the third pole of the mode switch, SW2a, grounds the inverting input resistor of U2a in all modes except stereo, so that in all mono modes it ignores the AF2 signal and acts as a simple buffer amp with a gain of 2.0.

As you can see, the mode switching in this receiver is purely manual, and there's also no 'stereo' indicator LED. This is for two reasons, the more important one being that since most Australian TV stations are now transmitting either in stereo, or in the original mono (i.e., with no 5.742MHz sound carrier at all, let alone a pilot subcarrier). This tends to make automatic mode switching and stereo indication not only difficult, but largely superfluous.

Another reason is that while the TDA3857 chip used in the receiver has internal detection of the 5.742MHz sound carrier, and muting of the AF2 output when it's not present, it provides no external indication of this ID/muting action. As a result, the only way to achieve both automatic mode switching and stereo indication is to use a companion chip, the TDA3803A. This provides a stereo dematrix stage and audio control section, plus a full 54.6875kHz pilot subcarrier amplifier/detector system, complete with bandpass filtering and detectors for the 117.5Hz and 274.1Hz audio ID tones.

During development of the receiver I tried out this approach, and it certainly works. However the pilot subcarrier detection circuit calls for an adjustable 1.5uH inductor, with a Q of 60 (not readily available), and the audio tone filters really needed an accurate audio signal generator to align them properly. So after trying it out, I finally decided that the extra complexity and cost simply isn't justified...

From SW2, the selected stereo or mono signals pass to the master volume control RV9/10, and thence to the output buffer amplifiers U2c and d. These are connected again as voltage followers, to provide a low output impedance for driving interconnecting cables. The buffer outputs are connected to the R and L output connectors via resistors R26 and R27, to protect them in case of accidental shorts.

This, then, is the basic stereo receiver. However the op-amps of U3 are used to provide the additional audio processing, for our 'extra' or derived surround-sound outputs.

The stage around U3c is used to subtract the R stereo signal from the L signal, to produce an L-R or 'ambience' signal. This can be fed to an amplifier driving one or more 'rear' speakers (either directly or via a delay circuit), to provide an enhanced 'surround' effect. Resistors R34 and R30 give U3c a gain of -1.0 as far as the R signal is concerned, while at the same time giving it a gain of +2.0 for the signal at the non-inverting input (pin 10). To balance this, resistors R31 and R42 are used to divide the L signal down by the same factor, to that the output of U3c becomes simply L-R.

Resistor R35 is again to protect the op-amp output from accidental shorts, although here it's also used in conjunction with C41 to limit the bandwidth of the L-R signal to around 7kHz. This is done in most surround-sound decoders, to prevent excessive disturbance of the stereo image.

In a somewhat similar fashion, U3d is used to produce a 'front centre' signal, by adding together the L and R signals to produce an L+R signal. (Yes, this will be basically the same as the original AF1/L+R signal. So why not simply use that signal? Because this way, our main volume control automatically adjusts *its* volume, along with the main L and R outputs...) Resistors R28 and R29 are used to add the L and R signals for U3d, with C40 again used to restrict the bandwidth of the L+R signal to around 7kHz.

The L+R output of U3d is also used to derive the subwoofer output signals, via op-amps U3a and U3b. U3a is used as a third-order low-pass filter, with its corner frequency set to approximately 100Hz. This produces the basic subwoofer out-

***Continued on page 99***

## PARTS LIST

### *Capacitors*

| | |
|---|---|
| C1,9,18,19,38,39 | 0.1uF monolithic ceramic |
| C2,3,4,5,12 | 10nF monolithic ceramic |
| C6,8,10,11,20,21,40 | 1nF monolithic ceramic |
| C7 | 22nF monolithic |
| C13 | 22uF tantalum electrolytic |
| C14,15,32,33,34,35 | 2.2uF tantalum electrolytic |
| C16 | 27pF NPO ceramic |
| C17 | 47pF NPO ceramic |
| C22 | 4.7uF tantalum electrolytic |
| C23,24 | 1000uF 25VW RB electrolytic |
| C25,26,27,28 | 33uF 35VW RB electrolytic |
| C29 | 100pF ceramic |
| C30,31 | 10uF tantalum electrolytic |
| C36,37 | 12nF MKT or met. polyester |
| C41 | 3.3nF MKT or met. polyester |
| C42 | 47nF MKT or met. polyester |
| C43 | 0.12uF met. polyester |
| C44 | 6.8nF MKT or met. polyester |

### *Inductors*

| | |
|---|---|
| L1 | 2.2uH RF choke, PCB mounting |
| L2 | 6T coil on 4.8mm former, with F29 slug, 6-pin base & shield can |
| L3,4 | 10T coil on 4.8mm former, with F16 slug, 6-pin base & shield can |

### *Resistors*

(All 1/4W 5% carbon unless noted)

| | |
|---|---|
| R1 | 4.7k |
| R2 | 3.3k |
| R3 | 39 ohms |
| R4,7,12 | 150 ohms |
| R5,10,11 | 470 ohms |
| R6,21 | 1k |
| R8,9 | 560 ohms |
| R14,17 | 1.8k |
| R15 | 10 ohms |
| R16 | 6.8k |
| R18 | 820 ohms |
| R19,20 | 220k |
| R22,23 | 20k 1% metal film |
| R24,25 | 4.7k |
| R26,27,32,35,38,41 | 680 ohms |
| R28,29,39,40 | 22k |
| R30,31,34,42 | 10k 1% metal film |
| R33,36,37 | 47k |
| RV1-6 | 100k 10-turn horiz trimpot |
| RV7 | 1k linear horiz trimpot |
| RV8 | 10k linear horiz trimpot |
| RV9 | Dual 50k log potentiometer |

### *Semiconductors*

| | |
|---|---|
| D1,2 | BB809 varicap diode |
| D3,4,5,6,7,8 | 1N4001 1A power diode |
| D9 | 12V 400mW zener diode |
| D10 | 4.7V 400mW zener diode |
| Q1 | BF173 NPN VHF amp transistor |
| U1 | TDA3857 quasi-split sound IC |
| U2,3 | TL074 quad FET input op-amp |
| U4 | 7812 +12V regulator (TO-220) |
| U5 | 7912 -12V regulator (TO-220) |
| U6,8 | 7805 +5V regulator (TO-220) |
| U7 | LM723 adjustable regulator |

### *Miscellaneous*

| | |
|---|---|
| SAWF1 | Murata SAF36.9MZ70Z SAW filter |
| CF1 | Murata SFT5.74MA ceramic filter |
| CF2 | Murata SFT5.5MA ceramic filter |
| M1 | Murata TUMUF4EA-721 tuner module |
| M2 | Hwa Lin HL-PIF 36MC05 VIF module |
| SW1 | Two pole 6-position rotary switch |
| SW2 | Three pole 4-position rotary switch |
| SW3 | Miniature SPST toggle switch |

Plastic case, 250 x 190 x 80mm; 3 x 20mm control knobs; PCB, 165 x 137mm, code 95tvs1; 44 x PCB terminal pins; 6-way RCA socket strip; BNC socket, single hole panel mount; power transformer, 30V/15V CT at 500mA; IEC mains connector, male panel mount; 3AG fuseholder with 250mA slo-blo fuse; 110 x 45 x 1mm aluminium plate for transformer mounting; T0-220 heatsink for U4 (+12V regulator); hookup wire, tinned copper wire, solder etc.

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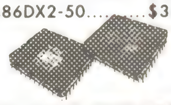
*Include Interface Card, PhotoFinish 3.0, MediaMate Presentation software, SmartPage Direct OCR software, TWAIN complaint software & User's manual.*

## LATEST CPU PRICE

| intel CPU | | AMD CPU | |
|---|---|---|---|
| 486SX-33 | $179 | 486DX-40 | $349 |
| 486DX-33 | $399 | 486DX2-50 | $379 |
| 486DX2-50 | $399 | 486DX2-66 | $379 |
| 486DX2-66 | $429 | 486DX2-80 NEW! | $579 |
| 486DX2-50 OverDrive Chip | $499 | **CYRIX CPU** | |
| 486DX-50 | $899 | 486DX-40 | $329 |
| 486DX-75 | $799 | 486DX2-50 | $369 |
| 486DX4-100 | $899 | | |
| PENTIUM 60MHz | $699 | | |
| PENTIUM 66MHz | $799 | | |
| PENTIUM 90MHz | $1195 | | |
| PENTIUM 100MHz | $1795 | | |



*AVAILABLE ON ORDER THROUGH OUR STORES OR BY MAIL ORDER*

## CREATIVE BLASTER CD 16
## MULTIMEDIA OFFICE

$899

X17242

Sound Blaster CD16 combined with Microsoft Office - a full featured Windows business integrated applications that include Word, Excel, PowerPoint, Access and also a workstation license for Mail.

Create quality documents with *Microsoft Word* and import information from other Microsoft programs.

Route your documents for review with *Microsoft Mail*. Include files, charts, graphics and more in your mail message.

Create and manage data fast with ***Microsoft Access***. Then send your data to Microsoft Excel for further analysis. With Microsoft Access.

*Microsoft Excel 5.0* - the most popular Spreadsheet for Windows. Add data directly to a chart with Drag-and-plot; easily work with other data using Autofilter, Sort and Subtotal.

*Microsoft PowerPoint 4.0* - the most popular presentation graphics programs for Windows. Present your ideas more effectively and create a visual presentation fast.

**PACKAGE INCLUDE:** SB 16-bit Sound Card ● Headphone ● Microphone ● Creative double-speed CD-ROM Drive ● Software - Creative VoiceAssist™ MS Windows Sound System 2.0 ● Microsoft Encarta CD ● Microsoft Office.

INSTALL FREE ON YOUR PREMISES. APPLY ONLY TO WITHIN 50KM OF OUR SERVICE CENTRE AT CLAYTON.

(1 HOUR ALLOWING. ON-SITE NORMAL SERVICE CHARGE APPLY FOR LONGER DEMOS CURRENTLY $75 PER HOUR.)

## COMPUTER CARDS - HUGE RANGE!!

### I.S.A.

| CAT NO. | DESCRIPTIONS | PRICE |
|---|---|---|
| X18075 | 1meg Trident/Cirrus VESA | $115 |
| X18077 | 512K TRIDENT VGA | $89 |
| X18004 | IDE/SPG | $29 |
| X18013 | IDE | $19 |
| X17072 | ADAPTEC SCSI 16bit 1522A | $199 |
| X18161 | *16bit ETHERNET NE2000 | $99 |
| X18169 | 16bit NE2000+ | $269 |
| X18151 | S.P.G. | $29 |
| X18181 | Printer 2-Port Slct Lpt 1-2 Card | $29 |
| X18190 | Printer Port Slct Lpt 1-2-3 Card | $39 |
| X18141 | High Speed Serial Card 1-Port 16550 | $59.95 |
| X18041 | High Speed Serial Card 2-Port 16550AFN | $99 |
| X18143 | High Speed Serial Card 4-Port 16550AFN | $189 |
| | S.P.G with 1655 UART CHIP | $44.95 |
| X18019 | Games Card | $19 |
| C14260 | SMART GAMES Cont | $39.95 |
| X18177 | CD ROM Controller | $45 |
| X19936 | ISA Scanner Card GS4500 | $79 |
| X17071 | ISA VGA Accelerator Pro | $275 |
| | 2.88 FDD Controller Card | $125 |

Specifications subject to changes. *X18161 without Boot Roms.

## 486 VESA MAINBOARD

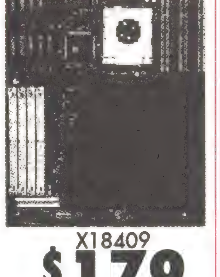
NEW

### DX4-100 MOTHERBOARD

**THE MOTHER OF ALL MOTHERBOARD THAT IS COMPATIBLE WITH EVERY CHIP FROM 486DX2/DX/SX/SL ENHANCED 486, P24T, P24D, DX4 TO THE CYRIX CPUs.**

FEATURES:

- Fully AT compatible. Supports 486DX2/DX/SX/SL Enhanced 486, P24T, P24D, 486DX4 (P24C) and Cyrix CPUs.
- Supports internal cache (CPU) write-back (P24T, P24D, M6/M7) systems
- Memory configuration from 1 MB to 96MB using combinations of 70ns 256K, 512K, 1M, 2M, 4M and 16M SIMM modules. Uses four 72-pin DRAM Banks in multiple configurations
- Seven 16-bit slots, two master VESA slots, and one slave VESA slot



X18409 $179

## Lexmark Colour Inkjet Printer

$699

600 dpi (with PQET) in black & 300 dpi in colour. Includes 150 sheet feeder. 300cps in black print mode and 240 cps in full colour.

## VESA LOCAL BUS

| CAT. | DESCRIPTION | PRICE |
|---|---|---|
| X18002 | VESA MULTI I/O | $39 |
| X18099 | VESA 1 Meg TRIDENT 9400 | $119 |
| X18100 | VESA CIRRUS 5428 | $139 |
| X18184 | VESA PARADISE 1Meg | $299 |
| X18186 | VESA IDE Cache Cont | $349 |
| X17071 | VESA SCSI 2, IDE, Floppy, Multi I/O | $299 |
| X18087 | VESA WD Accelerator Video Card | $209 |
| X18167 | VESA VGA S3 Accelerator | $139 |
| X18185 | VESA ET-4000 TSENG LABS | $245 |
| X18149 | VESA CLOUD9 VGA 2 MEG | $449 |
| X18047 | VESA IDE ENHANCED MULTI I/O | $139 |
| X18182 | VESA CACHED IDE MULTI I/O | $280 |

### P.C.I.

| CAT. | DESCRIPTION | PRICE |
|---|---|---|
| X17078 | PCI SCSI IDE FLOPPY MULTI I/O | $299 |
| X17900 | PCI 1M VGA | $249 |
| X18179 | PCI IDE CONTROLLER | $89 |
| X18181 | PCI DIAMOND VIPER 2MEG | $899 |

## HIGH END LOW-COST COLOUR SCANNING

***Affordable range of colour scanners with the choice of 1200 dpi or 24000 dpi***

Have your DTP efforts been deterred or limited by high-cost colour scanners? Wait no more. Here's a couple of high-end colour scanners at prices we all can afford to pay!

- **Brilliant colour** - add the power of brilliant 24 bit true colour images to your Window-based DTP and presentation packages.
- **High resolution** - up to 1200 dpi (ColorPage-I)/2400 dpi (ColorPage II), get scanned pictures that are clear and beautiful.
- **Powerful image software** - PhotoFinish 3.0 software provides 87 tools to satisfy your demands and realize your creativity.
- **TWAIN compliant** - expands scanner capabilities with compatible applications.

**Includes:**

Interface card, PhotoFinish 3.0, MediaMate Presentation software, TWAIN driver, User's manual.

**OPTIONAL:**

- **Power OCR** - optional Recognita Plus OCR means you'll never have to re-key data again. **Auto-Document Feeder** (ADF-I) and **Transparency Unit** (TMA-I).

*LIMITED EDITION SOFTWARE SUPPLIED*

$1199 X19933 ColorPage-I
1200 dpi flatbed scanner

$1699 X19934 ColorPage-II
2400 dpi flatbed scanner

**FREE PACK & POST FOR ORDERS OVER $20.00 TILL THE 31ST OF JANUARY'95.**

SWTMOTHR2

*ERRORS & OMISSION EXCEPTED. PRICES CHANGE WITHOUT NOTICE.*

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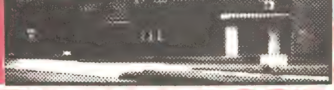
| MELBOURNE: A'BECKETT ST, MELBOURNE 3000. | PH: (03)663 6151 | FAX: (03) 639 1641 |
| VERMONT: 190 ROOKS RD, VERMONT 3133 (Mid Dec' 94) | PH: (03)874 8888 | FAX: (03) 874 2288 |
| OAKLEIGH: 240C HUNTINGDALE RD, OAKLEIGH 3166. | PH: (03)562 8939 | FAX: (03) 562 8940 |
| NORTHCOTE: 423 HIGH ST, NORTHCOTE 3070. | PH: (03)489 8866 | FAX: (03) 489 8131 |
| BOX HILL: 1031 MAROONDAH HWY. BOX HILL 3128. | PH: (03)899 6033 | FAX: (03) 899 0156 |
| CLAYTON: 56 RENVER RD, CLAYTON 3168. | PH: (03)543 7877 | FAX: (03) 543 8295 |
| BLUESTAR COMPUTERS: 271 MAROONDAH HWY, RINGWOOD 3134. | PH: (03)870 1800 | FAX: (03) 879 3027 |
| SYDNEY: 74 PARRAMATTA RD, STANMORE 2048. | PH: (02)519 3888 | FAX: (02)516 5024 |
| ADELAIDE: 241-243 WRIGHT ST, ADELAIDE 5000. | PH: (08)211 7200 | FAX: (08)211 7273 |

***WE ARE PLEASED TO ANNOUNCE THE OPENING OF OUR NEW RETAIL SHOWROOM, LOCATED AT 190 ROOKS ROAD, VERMONT, 3133, BY MID- DECEMBER 1994.***



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## OUR CHOICE OF GREAT VALUE & HIGH PERFORMANCE MULTIMEDIA SYSTEMS

WARNING: DON'T BUY OUT-DATED TECHNOLOGY. COME TO RIE FOR THE LATEST DX2-66 SYSTEM. WE ALWAYS HAVE THE LATEST PRODUCTS

AT A PREHISTORIC PRICE!
WOW!! ALL THIS AT A PREHISTORIC PRICE!

IDEAL FOR THAT XMAS GIFT OR LAYBY!

*3 HOUR EXPRESS DELIVERY SERVICE ON THIS SYSTEM ONLY!

☎ Just call and we will deliver. Credit card payment by phone

**$1899** EX. TAX

**$2199** INC. TAX

**FREE** HOME DELIVERY & SETUP WITHIN MELBOURNE METROPOLITAN AREA

## SOUND BLASTER MULTIMEDIA

### 486DX2-66 /420 HDD VESA LOCAL BUS 3 SLOT MOTHERBOARD FITTED

Here's another Value-Packed Budget-Priced MultiMedia 486DX2-66 System that will suit those who just want to enjoy the world of Music, Sound & Computer Games and yet is sufficiently powerful for that system intensive software! Place your order now!

**INCLUDES:** ● VESA Slot Motherboard ● 4 MEG RAM ● VESA 1 MEG SVGA Card ● Mini Tower Case and 200W P.S. ● 14" Non interlaced Monitor - 1024 x 768mm 0.28mm Dot Pitch ● Ritron Mouse Pad ● 101 High quality keyboard ● Sound Blaster 16 Sound Card ● Joystick & Mouse ● Creative CD-200 2x Speed MultiSession CD ROM Drive (feature front panel play/skip & stop/eject buttons. Listen to your favourite music CD at the touch of a button in true stereo)

**MULTIMEDIA ENTERTAINMENT:**
● SPEED Interactive Movie ● 3D Dinosaurs Adventure ● Groliers Encylopedia ● Text to Speech ● Wave Studio ● Ensemble Remote Control ● Sound O'Le WAV Recorder ● Creative 8 Channel Mixer ● Mosaic Board Game ● CD Play Utility ● FM Intelligent Organ

**420MB HDD - GREAT VALUE!**

**HARDWARE/SOFTWARE CONFIGURATION FOR BOTH SYSTEM:**
- ☐ 1.44 -3.5" Floppy Disk Drive
- ☐ VESA I/O Card
- ☐ Magnetically shielded Speakers
- ☐ MS DOS 6.2
- ☐ Windows 3.11

**4 YEAR PARTS & 2 YEAR ON-SITE LABOUR WARRANTY MELB MET AREA**

***SUBJECT TO AVAILABILITY OF STOCK IN HAND**

NOW COMES WITH 15" XGA ANALOG FLAT SCREEN MONITOR 1280 x 1024 D.P. N.I
MONEY

**$2520** EX. TAX

**$2895** INC. TAX

SOFTWARE BONUS EXTRAS!!
MS 1994 ENCARTA
MS MONEY
PHONEDISC

LATEST GRAPHIC ACCELERATOR CARD

| CPU OPTIONS ..... | TAX INC | TAX EX |
|---|---|---|
| Pentium 66 .... | $3199 | $2800 |

## PENTIUM 60 MULTIMEDIA SYSTEM PRO

### LATEST TECHNOLOGY - PENTIUM 60/66 MOTHERBOARD

Step up to power computing with the stupendous power of th e Pentium 60MHz CPU. This is an enhanced version of our basic 486DX2-66 multimedia system. This system offers faster graphics, expansion flexibility in a midi tower case.

**540MB HDD/FAST ATA BUS CONT CARD**

**INCLUDES:** ◆ PCI & VESA LB slots ◆ VESA LB components, including: I/O Card, Video Card & Motherboard. ◆ 4MB SIMM RAM exp to 128MB ◆ Midi Tower Case and 200W P.S. ◆ Chicony high quality keyboard ◆ Internal Double Speed CD ROM drive, (Photo CD compatible)- plays the latest video software. ◆ 16 Bit Sound Card (SBlaster compatible) ◆ Slimline Joystick ◆ Ritron Mouse ◆ MS Works for Windows* *PREINSTALLED*, $1,000 of value compared to what you used to pay for individual programs! Spreadsheets, Database, Word Processing and Mailing Lists all intergrated in one program. Learn these useful programs at your own pace, with the in-built help text and illustrated tutorial!

**Microsoft 1994 Encarta** - Saves hours in the library. Easy to find information. Funk and Wagnalls 29-volume encylopedia with more than 1,000 additional articles, eight hours of sound, 60 languages samples, 7,800 photos & ilustrations, 100 animations & video clips, 800 maps, 100 interactive charts and an atlas all on a CD-ROM.

**Microsoft Money** - Personal financial organisation made easy. Has a calculator, currency conversion module. Easy spreadsheet and on-line bank payment or transfer capability.

**Phonedisc**-The latest in Australian Directory Assistance. Allow you to find virtually any business numbers in Australia, including Fax Numbers.

FREE 3 HOUR COMPUTER TRAINING COURSE- MELBOURNE ONLY

USE YOUR DINERS CLUB/AMEX CARDS TO GAIN FLYER POINTS! APPLYS TO THIS MULTIMEDIA SYSTEM PRODUCT OFFER ONLY.

## COMPUTER SYSTEMS

**FREE** 3 HOUR TRAINING COURSE (MELB. ONLY) FOR ALL COMPUTER SYSTEMS INCLUDING MULTIMEDIA SYSTEMS

| System | Price | Tax Inc |
|---|---|---|
| 386DX 40 | $1040 | $1259 |
| 486SX 33 (With upgradable motherboard) | $1239 | $1499 |
| 486DX 40 (CYRIX CPU) | $1239 | $1499 |
| 486DX2 50 (CYRIX CPU) | $1259 | $1519 |
| 486DX2 66 | $1299 | $1579 |
| 486DX2 80 (NEW) | $1569 | $1879 |
| 486DX4 100 | $1989 | $2399 |
| PENTIUM 60 External 256K Cache | $1795 | $2171 |
| PENTIUM 90 External 256K Cache | $2499 | $2999 |

SYSTEMS NOW COME WITH NON-INTERLACED MONITOR

**DISCOUNTED SOFTWARE**

| | |
|---|---|
| DOS 6.22 | *$89 |
| M.S WORKS | *$99 |
| DOS 6.22 & Win 3.11 | *$149 |
| DOS 6.22 & Windows for WorkgroupS | *$179 |
| MS MONEY | *$44 |
| MS BOOKSHELF | *$99 |
| MS Encarta '94 | *$89 |
| MS Office | *$695 |

* When purchased with a system only.

**4 YEAR PARTS & LABOUR WARRANTY**

All systems include 260 MEG Hard Disk ● 4 MEG RAM ● 101 Keyboard ● 14" Non interlaced SVGA (1024 X 768) (0.28" DOT PITCH) Colour Monitor 2SPG Ports ● 1.44 MEG 3½" FDD ● Mini or Baby AT casing ● 3 Slots VESA Local Bus Motherboard & VLB 1MB VGA Cards are supplied in 386 machines AT NO EXTRA COST (Up to 1280 x 1024) Resolution

★★★★★★ CASH SPECIALS ★★★★★★

ONLY AVAILABLE WHEN PURCHASING SYSTEMS: CREATIVE LABS CD ROM DRIVE & SOUND BLASTER 16 VALUE EDITION AUDIO CARD INCLUDING DRIVERS CABLES AND THREE SOFTWARE CD TITLES SPEED ● THE NEW GROLIERS ENCYLOPEDIA ● 3D DINASOURS

SUPA SPECIAL* $449

## IBM ExecJet II 4076 Printer
**by Lexmark**

*Ink-jet printer for high quality text & graphics. Output on envelopes, paper labels & transparencies*

- *300 x 300 dpi, 3ppm*
- *Print Quality Enhancement Technology for smooth images*
- *Emulation mode - PCL3 & IBM PPDS*
- *Serial interface (RS-232, RS-422)*

NEW **$499**

Comes with Power Cord, User's Guide, Driver Software, etc.

## FLOPPY DRIVES

| | |
|---|---|
| 1.44 Mb 3½" F.D.D. | ... $59 |
| 1.2 Mb 5¼" F.D.D. | ... $89 |

**RITRON** 3 button mouse.......$19.95

## COMPUTER CASES

| | |
|---|---|
| MINI TOWER CASE 200W P.S. | $69 |
| FLIP TOP CASE 200W P.S....... | $75 |
| MIDI TOWER CASE 200W P.S.................... | $129 |

## MEMORY

| | 1-9 | 25+ | 100+ |
|---|---|---|---|
| **30 PIN SIMM** | | | |
| 1M x 9-60 With Parity | $79 | $77 | $75 |
| 1M x 8-70 No Parity | $65 | $63 | $59 |
| 1M x 9-70 With Parity | $69 | $65 | $62 |
| 4M x 8-70 No Parity | $239 | $229 | $219 |
| 4M x 9-70 With Parity | $249 | $239 | $219 |
| **72 PIN SIMM FOR PENTIUM M.B** | | | |
| 4M X 8-70 No Parity | $269 | $245 | $239 |
| 4M X 9-70 With Parity | $289 | $265 | $259 |
| 8M X 9-70 With Parity | $569 | $549 | |
| 16M X 9-70 With Parity | $999 | $979 | |

## HARD DRIVES VOICE COIL IDE HD

| Cap | Av.Access | Tax Inc. | Tax Ex. |
|---|---|---|---|
| 212M | 16ms | $272 | $225 |
| 260M | 16ms | $277 | $229 |
| 345M | 12ms | $299 | $249 |
| 420M | 12ms | $360 | $299 |
| 540M | 12ms | $442 | $350 |
| #730M | 10ms | $599 | $495 |
| #810M | 10ms | $799 | $660 |
| #1.08GB | 10ms | $899 | $739 |

#These drives come with Disk Management Software to overcome DOS limitations. (Drives will normally go to 525MByte max).

## 3.5" FLOPPY DISK BOX

HOLDS 40 NO LOCK

| 1-9 | 10+ |
|---|---|
| $4.95 | $4.50 |

## 101 KEYBOARD Update now!

With 2 year warranty.

| 1-9 | 10+ |
|---|---|
| $24.95 | $23.00 |

## BASIC UPGRADE- USE YOUR EXISTING "AT" HARDWARE

*We supply assembled & tested-*
● Mini Tower ● DX2-66 M.B. with CPU ● 4MEG RAM ● 1M VESA VGA ● 12 months warranty

**$899**

DO IT YOURSELF

*Optional CPU:*
DX2-50...$849
DX40....$839

## INK JET CARTRIDGE REFILLS ON SPECIALS

JUST IN THE DOOR!!

SPECIAL FOR ONLY **$12.95**

**TJC-202** SUITABLE FOR CANON BC-01, CANON BC-02

**TJC-626** SUITABLE FOR HEWLETT PACKARD DESKJET SERIES

## MOTHERBOARDS

| | |
|---|---|
| 386SX-40* LM 47 | $129 |
| 386DX-40* 8K Internal Cache LM63 | $169 |
| 386DX-40* 128K Internal Cache LM58 | $199 |
| 486DX-40* 256K Cache L.B. CYRIX CPU | $359 |
| 486DX2-66* 256K Cache L.B | $489 |
| 486DX2-80* 256K Cache L.B | $795 |
| 486DX4-100 256K Cache L.B | $1189 |
| *NEW* PENTIUM 60MHz/256 C VESA/ISA | $999 |
| *NEW* PENTIUM 90MHz PCI/VESA | $1889 |
| *NEW* PENTIUM 100MHz PCI/VESA | $2695 |

*AMD CPU. Without Asterisk- INTEL CPU

## Maestro Modems

| | |
|---|---|
| 28.8 FAXMODEM EXT 28,800BPS .... | $499 |
| 28.8 FAXMODEM INT 28,800BPS ..... | $449 |

## CD ROM DRIVES

| | |
|---|---|
| WEARNES OEM DUAL SPEED CD ROM MULTIMEDIA KIT *with 16-bit Sound Card instructions & software* | $379 |
| WEARNES CDD-110 DUAL SPEED CD ROM IDE DRIVE *with instructions & software* | $239 |
| WEARNES CDD-120 DUAL SPEED CD ROM IDE DRIVE *with inst & software* (CD-I Compatible) | $249 |
| 562B CD ROM DRIVE DOUBLE SPEED *with software drivers for all drives* | $199 |
| 563B CD ROM DRIVE DOUBLE SPEED *works with all Sound Blaster Cards* | $289 |
| *NEW* GRAND MPEG CARD | $499 |

*Display CD-I movies on VGA monitor!*

## 16550 UARTS
FOR FAST SERIAL PORTS..$17.95

## FAX ROLLS ON SPECIALS

| | 1-9 | 10+ |
|---|---|---|
| 210 x 11.5 x 30m | $4.95 | $3.95 |

## BULK DISK PRICES

PRICES ARE PER BOX OF TEN DISKS

All disks come with Write Protects and envelopes and a life time warranty.

| DESCRIPTION | 1-9 | 10+ | 50+ | 100+ | 500+ |
|---|---|---|---|---|---|
| 5¼ DS/DD | $4.50 | $4.50 | $4.50 | $4.30 | $3.95 |
| 5¼ DS/HD | $7.95 | $7.75 | $7.50 | $6.90 | $6.90 |
| 3½ DS/DD | $6.50 | $6.30 | $6.25 | $6.00 | $6.00 |
| 3½ DS/HD | $6.50 | $6.30 | $6.00 | $5.90 | $5.75 |

## THE COMPLETE IDIOT'S GUIDE TO THE INTERNET

**$24.95** FREE DISK!*

The best Internet reference book for beginners. Get the *Most* from the World's LARGEST NETWORK.
*ANOTHER GREAT VALUE PACK!*
*Include E-Mail utility & other cool Internet stuff!

## NEW MONITOR RANGE:

*All these superb monitors on display at all Stores*

| | |
|---|---|
| 14" Non-interlaced 1024x768 (0.28mm Dot pitch) | $349 |
| 15" XGA Analogue 1280x1024 | $499 |
| 15" XGA Digital 1280x1024 | $599 |
| #15" XGA Digital MPRII European Furniture Style 1280x1024 | $695 |
| #15" XGA Digital MPRII 1280x1024 | $675 |
| #17" XGA Digital MPRII 1280x1024 | $1199 |

*#15" & 17" Digital Monitors comes with Economy Management Software.*

## QUICKEN SOFTWARE RANGE..

| | |
|---|---|
| Quicken Version 3.0 | $69.00 |
| QuickInvoice | $79.00 |
| QuickTax | $59.00 |
| QuickLine | $79.00 |
| QuickBooks | $199.00 |
| Quicken Duo Pack (Quicken & QuickTax) | $95.00 |

## NETWORK SOFTWARE

| | |
|---|---|
| DR DOS 6.0/NW Lite 3-H | $230.00 |
| DR DOS LANPACK V6.0 (50 USER) | $4,800.00 |
| NETWARE 4.01 (50 USER) | $9,995.00 |
| UNTOUCHABLE NETWORK NLM 1.1 | $1,450.00 |

## SOUNDBLASTER CARDS

| | |
|---|---|
| *NEW Sound Blaster Pro VALUE EDITION with Lemmings & Indy 500* | $110 |
| Sound Blaster Deluxe | $69 |
| Sound Blaster 16 bit | $189 |
| ASP Chip | $99 |
| Video Blaster SE | $479 |
| Video Blaster FS200 | $599 |
| Game Blaster CD16 Pk 7 CD Titles | $799 |
| TV CODER | $279 |
| 16 bit Discovery Pack CD16 | *$489* |
| 8bit Discovery Pack CD8 | *$399* |

PRICE CRASH

## EPSON PRINTERS DISCOUNTED PRICING

| | | |
|---|---|---|
| LX300 | *264 Cps Draft, 9 pin dot matrix* | $249 |
| LQ100 | *200 Cps Draft, 24 pin dot matrix* | $279 |
| LQ150 | *216 Cps Draft, 24 pin dot matrix* | $369 |
| | With colour option | $399 |
| Stylus 400 | *48-nozzle inkjet, 180Cps, 360dpi* | $419 |
| Stylus 800+ | *48-nozzle inkjet, 255Cpi, 360dpi* | $499 |
| Stylus Colour | *200Cpi, 360/720dpi full colour* | $1099 |
| EPL 3000 | *300dpi, 4ppm, laser printer* | $949 |
| EPL 5200 | *300dpi, 6ppm, laser printer* | $1199 |
| EPL 5600 | *600dpi, 6ppm, laser printer, RISC* | $1599 |

## BITSTREAM FONT PACK

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|---|---|
| THE FLINTSTONES | $34.95 |
| LOONEY TUNES 1 | $34.95 |
| THE JETSONS | $34.95 |
| WINTER HOLIDAYS | $34.95 |
| STAR TREK | $34.95 |

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| BOX HILL: 1031 Maroondah Hwy. | Ph: (03) 899 6033. | Fax:(03) 899 0156 |
| ADELAIDE: 241-243 Wright St. | Ph. (08) 211 7200. | Fax:(08) 211 7273 |
| SYDNEY: 74 Parramatta Rd , Stanmore. | Ph: (02) 519 3888. | Fax:(02) 516 5024 |

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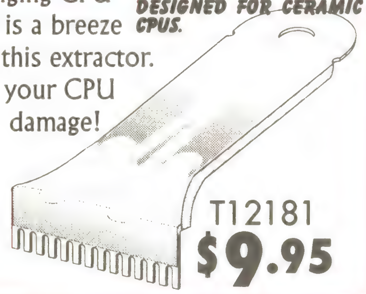

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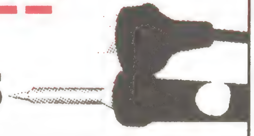

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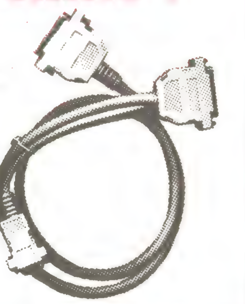

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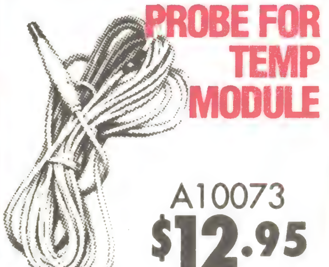

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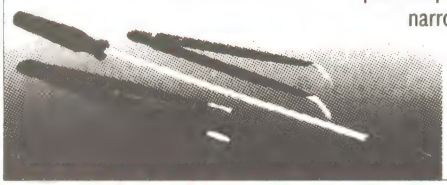

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This EPROM eraser has a timer that allow you to "set and forget". Choose from range of different settings from 15 minutes to 40 minutes depending on the intensity of the UV source. The chip door has a conductive foam pad.
Dimensions:
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| | |
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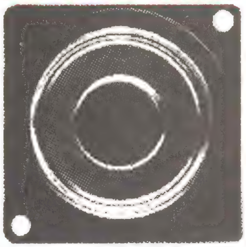

C10609
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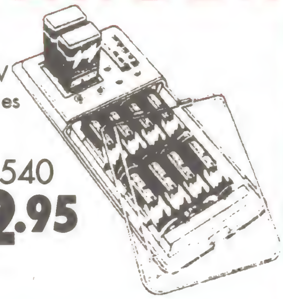

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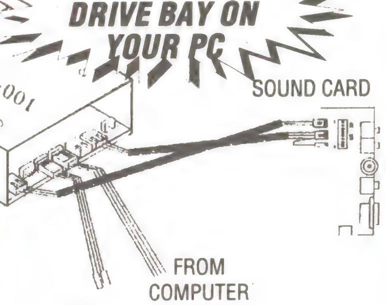

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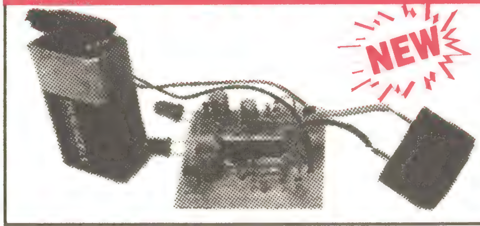

Meet Clifford - our new little pesky insect friend. A cousin of Horace the Cricket, he has a lot to say - provided it's dark. He's easy to look after & doesn't eat very much - one 9V battery will do him for a month!

**Silicon Chip Dec' 94**

K10640
**$16.45**

## 3-SPOT LOW DISTORTION SINEWAVE OSCILLATOR

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**Silicon Chip Dec' 94**

K10645
**$49.95**

## A BUDGET PRICED "SHOESTRING" STEREO AMP

With a power rating of around 15 watts per channel and impressive noise and distortion performance, this new low cost amplifier is ideal for small hi-fi systems, "home theatre" installations, and a host of other applications. It uses readily available parts, offers a basic range of features, and is very easy to put together. Ideal for school. College or University project or built to work as a computer multimedia amplifier.

**EA Dec'94**

***GREAT VALUE! IDEAL FOR SCHOOL PROJECT.***

K10650
**$99.95**

## NICAD ZAPPER

K10595
**$29.95**

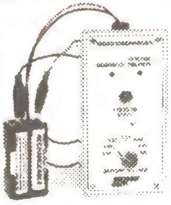
Do you have a few suspect Nicad batteries lying around in your kitchen drawer? Why not try bringing them back to life with this Nicad Zapper? It zaps the cell with a high-voltage, high-current burst to blast away any internal shorts caused by dendrites.

**Silicon Chip August '94**

## Automatic discharger for Nicad battery packs

If you own equipment which uses Nicad batteries, then this discharger is for you. Use correctly, it will maintain the full capacity of your battery pack & extend its useful life. It can even rejuvenate an old battery pack that's suffering from the memory effect.

**Silicon Chip Sept '94**



K10620
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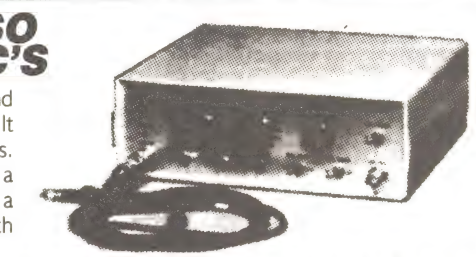
## AN IMPROVED DSO ADAPTOR FOR PC'S



Use this audio *DSO to display, store and output samples waveform from your PC. It uses only a small number of low-cost ICs. Features a calibrated vertical amplifier, with a maximum input sensitivity of 1V full scale, a calibrated sampling timebase, circuitry which allows direct control from PC software.

**EA Feb '94**

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# Circuit & Design Ideas

Interesting circuit ideas from readers and technical literature. While this material has been checked as far as possible for feasibility, the circuits have not been built and tested by us. We therefore cannot accept responsibility, enter into correspondence or provide further information.

## Simple shed alarm

Here is a circuit I used as an alarm for my backyard shed. It uses a dedicated piezo siren/strobe costing $30 from Jaycar, which is ideal for the job. A separate siren driver circuit could be added, and an eight-ohm horn speaker used instead.

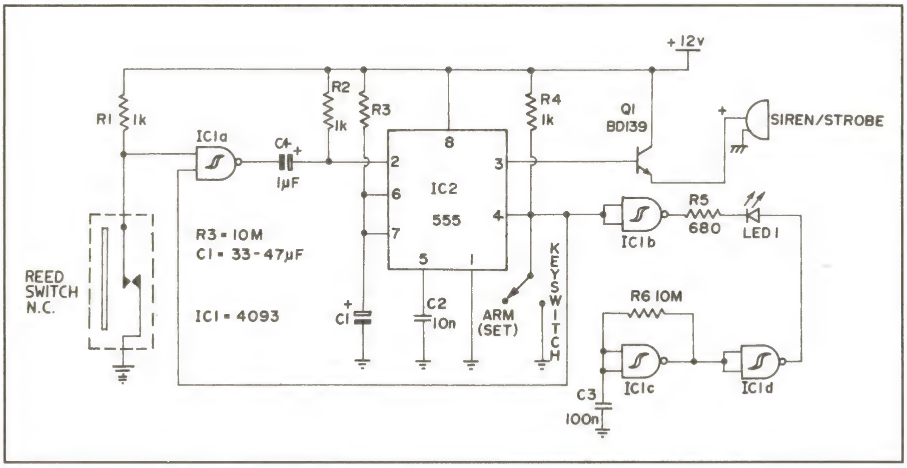
The sensor is a normally-closed magnetic reed switch on the front door of the shed, and the whole circuit is powered by a 1A 12V plug-pack, via a 12 volt regulator. The alarm is armed by a key switch after the door has been closed and an LED indicates the alarm is active. The whole thing cost about $100 — not much compared to a couple of thousand dollars worth of tools.

When the door is closed, one input to IC1a is held low by the reed switch. When the alarm is armed, the other input of IC1a and both inputs of IC1b are set high and the output of IC1b goes low, allowing the LED to flash with the oscillator formed by IC1c and d (set at about 1Hz). When the door is opened, or if the wires from the door switch are cut, both inputs of IC1a go high, giving a low at its output, which triggers the 555 timer.

Capacitor C4 ensures a pulse length sufficient to trigger the 555. Otherwise if the door is left open, the timer will always be in the triggered state and the alarm will sound continually, which is against most council regulations. The time delay is set with R3 and C1 to last for about eight minutes, which is the legal time limit for most built-up areas. (Note that the tolerance of electrolytics is such that you might need to experiment to get the eight minutes.) The 555 output is directly coupled to Q1, a BD139 which in turn supplies power to the siren. A heatsink is needed for this transistor, as a typical siren takes about 500mA.

Kerry Helman,
Salisbury, SA.

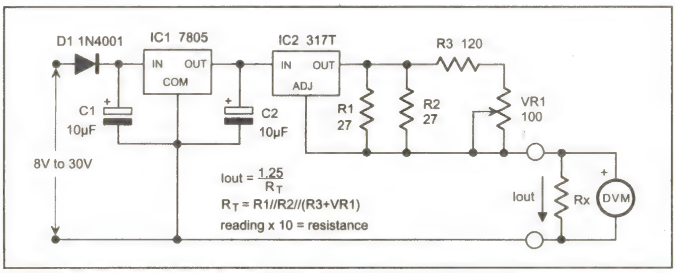
**$45**



## DVM milliohm adaptor

I designed this circuit when I recently needed to know the winding resistance of an inductor. As most digital multimeters don't have enough resolution for low resistance measurement, I decided to build a circuit based on Ohm's law, in which the voltage drop across a resistor is proportional to its resistance and the current flowing through it.

This circuit applies a constant current of 100mA to any resistance less than 36 ohms. So if the resistance is 1.3 ohms, a DVM will read 0.13 volts. Note that the reading in volts must be multiplied by 10 to give the resistance in ohms. A value of 100mA was chosen to keep the power dissipation small enough for use with low power resistors. For example, a 22 ohm resistor will dissipate 0.22W of power.



The constant current is produced by IC2, a variable voltage regulator. This IC maintains a constant voltage of 1.25V between its output and adjust terminals. Therefore if a resistance of exactly 12.5 ohms is wired across these terminals, a constant current of 100mA will flow in the load, regardless of its resistance.

A constant voltage of 5V is supplied to IC2 by IC1, a 3-terminal 5V regulator. This reduces the power dissipation in IC2 so no heatsink is needed, and also improves the regulation of the test current. Calibration is done by connecting an ammeter across the output and adjusting VR1 for exactly 100mA. Confirm that this value doesn't change by more than 0.1mA when a resistance of 10 ohms is connected in series with the ammeter.

Manfred Schmidt,
Edgewater, WA.

**$30**

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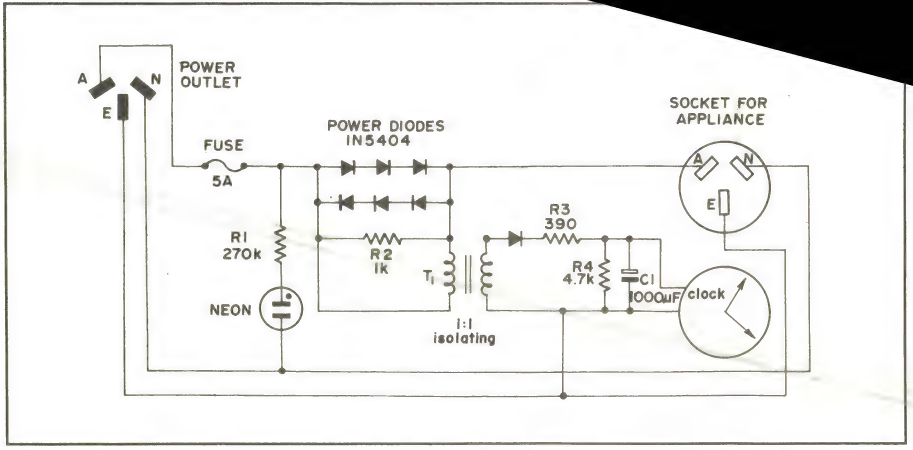
P.S. Don't forget to include your name, address and telephone number for contact in case of any queries.

## gy auditor

anted to do a couple of energy audits home, which involved checking the ing time of various appliances, like fridge. I remembered the 240V Power ay master/slave project in the January 2 issue of *EA*, so I modified it to drive a mall battery-operated clock, which mounts on the case.

Resistor R2 was retained, but with a reduced value, to de-sensitise the circuit so the switch wasn't triggered by the fridge light, fan and so on.

The value of R3 was determined by experiment to give 1.32V to the clock. Resistor R4 discharges the capacitor so the clock will stop when the appliance is off. The circuit works well, and faithfully records the operating time of an appliance.



R.C. Hilton,
Mt Pleasant, WA. **$30**

## Efficient linear power supply

This is a circuit of a 1.25 to 30V DC, 3A laboratory power supply based on the LM-350K regulator. To alleviate the problem of high power dissipation in the regulator at low output voltages and high currents, a tap changer is inserted between the transformer and filter.

It allows the filter voltage to roughly track the output voltage, switching the filter to progressively lower taps as the output voltage is reduced, and vice-versa. This allows a smaller heatsink for the regulator and thus a more efficient power supply. Under short-circuit conditions, the filter is automatically switched to the lowest tap, minimising heat buildup in the transformer. The table shows tap voltage versus output voltage.

The tap changer consists of two DPDT 12V relays and drivers, and an unregulated 12V auxiliary power supply. Depending on the mains voltage in your area, you might need to add one or more diodes in series with D4 to reduce the unregulated voltage.

To avoid shorting the secondary winding of the transformer, the circuit uses break-before-make switching. If the output voltage is between zero (short-circuit at the output) and 8V, neither relay is energised, leaving the filter connected to the 'default' tap of 12V AC.

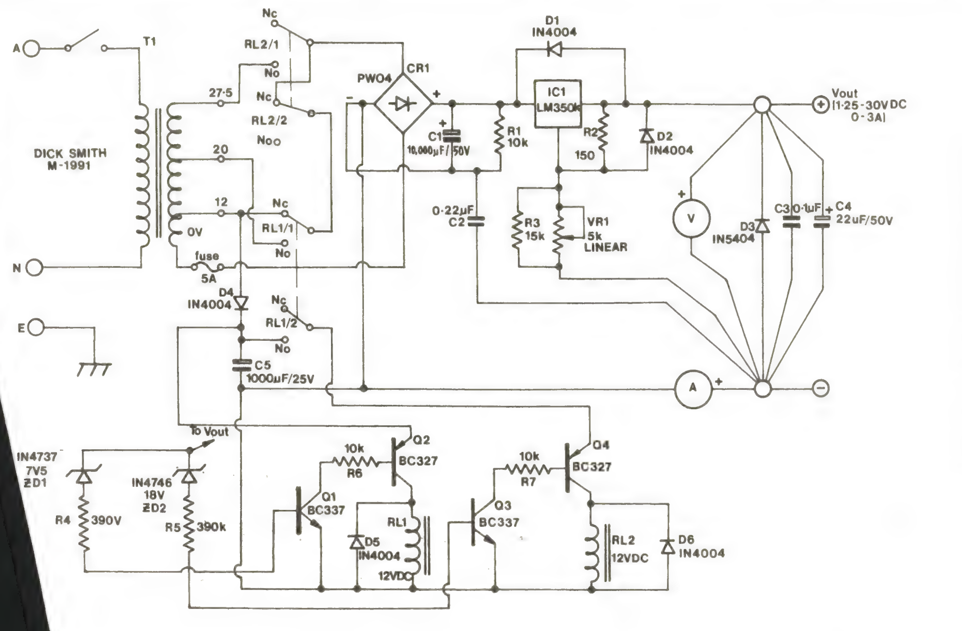
When the output voltage exceeds 8V, relay RL1 is energised, switching the filter from the 12V to the 20V tap. Similarly, when the output voltage exceeds 18V, relay RL2 also becomes energised (via RL1/2), switching the filter from the 20V tap to the 27.5V tap. The relay drivers have about 0.5V of natural hysteresis to prevent relay chatter at tap changeovers. The amount of hysteresis can be varied by varying the values of R4 or R5.

For improved load regulation, the ammeter is placed in the negative rail to allow the regulator to compensate for the (albeit) small voltage drop across the ammeter.

The ground end of VR1 and R3 is connected as close as possible to the load ground and the positive end of R2 as close as possible to the regulator output.

D1, D2, and D3 provide protection for the regulator if the power supply is used with external voltage sources, and R1 is a bleed resistor for C1 after power down.

Ron McGregor,
Belconnen, ACT. **$50**

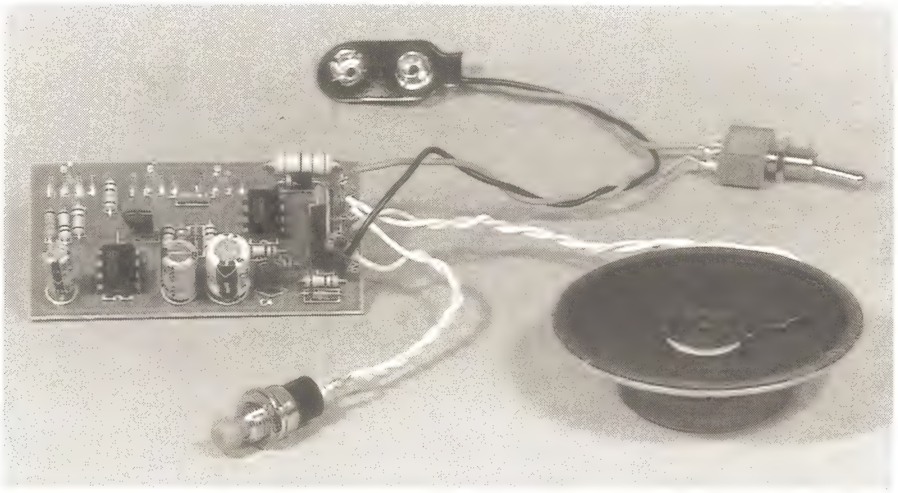


| Output voltage (V DC) | Transformer tap (V AC) |
|---|---|
| 0V (before power-up or a short-circuit) | 12 |
| 1.25 to 8 | 12 |
| 8 to 18 | 20 |
| 18 to 30 | 27.5 |

### ery Series' Construction Project:

# R-SOUND SIREN GENERATOR

Second release in the new Discovery Series of learning kits from Dick Smith Electronics is this Four-Sound Siren Generator, which as the name suggests uses only a small number of low-cost parts to provide a selection of four different 'siren' sounds — ranging from a 'wail' to a 'hee-haw'. Designated as Cat. No. K-2801, the kit for this project it is available in DSE's stores for $16.95.



With this project you can make the following four types of siren sounds: a 'wail' of the type produced by police sirens, a single 'yelp' (i.e., a single burst of wail), a 'whoop' rather like a submarine dive alarm, and a 'hee haw' of the type produced by an ambulance siren. Actually by experimenting with component values, an even wider range of sounds can be obtained — so it's a great project for those who like to experiment.

The desired sound is selected either by connecting wire straps on the PCB as instructed, or else by wiring the board up to a three-pole, four way rotary switch (not supplied in the kit). This can then be used to allow quick and easy selection of any one of the four sounds.

The project as described (and the kit as supplied) can operate from 6V to 9V DC, but a single component change can be made in order to operate it from 12V if you wish.

If you want to set up the siren in a box, the printed circuit board has been made the right size to slide directly into a 'UB-3' size Dick Smith Electronics 'Zippy' box (Cat. No. H-2853) measuring 130 x 68 x 41mm. A template is supplied with the kit for drilling the speaker and switch holes in the box lid. To get the basic kit going, the only other part you will need is a 9V battery (size 216).

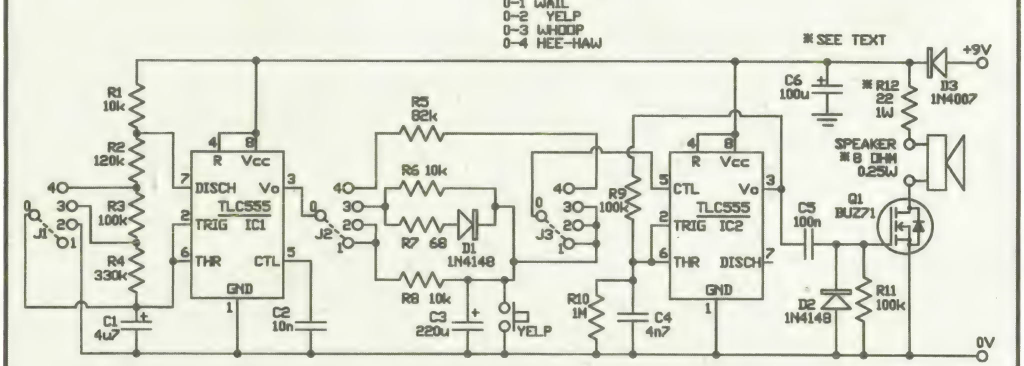
## Construction

All of the components except the battery and yelp button are mounted on a small printed circuit board, measuring 62 x 33mm and coded ZA-1201.

Begin construction by installing the resistors on the PCB. Look at the overlay diagram to find the part number, then look down the parts list to find the value required.

The parts list shows the colour code that will be on the resistor to identify its value. The last band of the colour code (the tolerance value) is the one that is furthest from the others. Resistors can be mounted in either direction, but it is good practice to mount them with their colour codes all in the same direction, to make it easier to check the values...

Next mount the diodes D1, D2 an
D3. These have to be mounted in th
right direction, with the stripe n
one end of the diode body



*As you can see fro*
*schematic, the sir*
*project develops*
*of sounds usin*
*low cost ICs, a*
*power MOSF*
*There's plen*
*experimen*
*operation*

responding to the striped end shown on the overlay diagram.

Next mount the polyester capacitors C2, C4 and the ceramic capacitor C5. These can be mounted in either direction.

Then mount the electrolytic capacitors C1, C3 and C6. Note that these are polarised and can be damaged if operated with the leads reversed. The outside of the capacitor case is normally marked with a stripe and a negative (-) sign near one of the leads, the other lead being positive (+). The overlay diagram shows where the positive lead goes.

Next mount the power MOSFET transistor, Q1. Position it so that the metal tab is facing away from the centre of the PCB, as shown on the overlay. Now you can mount the two integrated circuits, IC1 and IC2.

**NOTE that the TLC555 used for both devices is a CMOS type, which is sensitive to static electricity. To ensure they aren't damaged, remember to take the following precautions:**

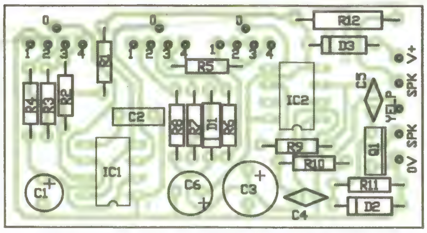
- Do not remove them from their protective foam until you are ready to install them.
- Avoid touching the pins with your fingers.
- Make sure that your soldering iron is properly earthed.
- Solder the power and earth pins of the IC (pins 1 and 8) to the board first.
- Mount the IC's so that the end with the notch in it is orientated as shown on the overlay diagram.

Now wire the battery clip, power switch and yelp button to the terminals at the end of the board.

If only one of the siren sounds is to be used, then three links have to be installed on the board. The table above the circuit diagram shows which links to install for each siren. If a three-pole four way switch is used to allow convenient switching between sounds, then wire the pads on the PCB to the corresponding terminals of the switch.

## Using other voltages

With the speaker supplied in the kit, which has an 8 ohm voicecoil and a rating of 0.25W, supply voltages other than 9V can be used simply by changing the value of series resistor R12, as shown in the table below:



***The overlay diagram shows where everything goes on the PC board. Note that the three sets of terminal pins at upper left can either be fitted with links, or connected to a three pole rotary switch to select the sound produced.***

| SUPPLY | R12 |
|---|---|
| 6V | 12 ohms/0.5W |
| 9V | 22 ohms/1W |
| 12V | 100 ohms/1W |

## How it works

The circuit for the siren consists of an audio frequency oscillator using a 'CMOS 555' timer (IC2), a low frequency oscillator also using a CMOS 555 (IC1), which is used to vary the frequency of IC2, and an audio power amplifier using BUZ71 power MOSFET (Q1) to drive the speaker.

Working backwards, the output of IC2, at pin 3, has a rectangular waveform which is capacitively coupled by C5 to the gate of Q1, which is an N-channel MOSFET. Diode D2 clamps the gate signal to above 0V and R11 pulls it quickly down to 0V when there is no signal. When the gate voltage is 0V, the drain-source channel of Q1 does not conduct; but when it rises to above about 1-3 volts, the drain-source channel becomes a very low resistance and connects the speaker across the supply via R12.

The output frequency of IC2 is determined by the values of components R9 and C4, and also by the voltage applied to its control voltage input (pin 5). In this circuit R9 and C4 are fixed in value, and only the control voltage is used to 'sweep' the frequency — to get the characteristic siren sound required. The higher the control voltage, the lower the output frequency.

If pin 5 is left unconnected, its voltage becomes 2/3 of Vcc, and the output at pin 3 is a square wave with a frequency given by the following formula:

**Fo = 1/(1.39 * R9 * C4) Hz**

Here the control voltage for IC2 comes from the output of IC1, via some passive components which alter its amplitude and/or its rate of change.

Except when the 'yelp' sound is used, the output of IC1 is a square wave which determines the repetition rate of the siren. The total time between repeats is given by the following formula:

**T = 0.693 * (R1 + 2 * Rx) * C1 seconds,**

where Rx is the total resistance between pins 6 and 7 of IC1.

For the 'wail' sound, links J1, J2 and J3 are all placed in the 0-1 position. This link for J1 produces the lowest repetition rate from IC1. The square wave output of IC1 is fed via R8 to C3, which develops an almost triangular waveform as the control voltage for IC2. This waveform causes the output frequency of IC2 to sweep up and down repetitively.

C3 can be varied if desired, to change the sweep width of the output. To change the frequency range, C4 can be varied.

To get the 'yelp' sound, links J1/J2/J3 are all placed in the 0-2 position. This applies 0V to pins 2 and 6 of IC1, which forces the output of IC1 to rise to Vcc (i.e., the positive battery voltage). This causes C3 to charge up close to Vcc, which in turn causes the output of IC2 to go to Vcc. The circuit remains in this state while the button is not pressed.

## PARTS LIST

### Resistors

(All 0.25W 1% unless otherwise stated)

| | | 4-band code | 5-band code |
|---|---|---|---|
| R1,6,8 | 10k | Brn-Blk-Org-Brn | Brn-Blk-Blk-Red-Brn |
| R2 | 120k | Brn-Red-Yel-Brn | Brn-Red-Blk-Org-Brn |
| R3,9,11 | 100k | Brn-Blk-Yel-Brn | Brn-Blk-Blk-Org-Brn |
| R4 | 330k | Org-Org-Yel-Brn | Org-Org-Blk-Org-Brn |
| R5 | 82k | Gry-Red-Org-Brn | Gry-Red-Blk-Red-Brn |
| R7 | 68 ohms | Blu-Gry-Blk-Brn | Blu-Gry-Blk-Gld-Brn |
| R10 | 820k | Gry-Red-Yel-Brn | Gry-Red-Blk-Org-Brn |
| R12 | 22 ohms 1W | Red-Red-Blk-Brn | Red-Red-Blk-Gld-Brn |

### Capacitors

| | |
|---|---|
| C1 | 4.7uF 25VW RB electrolytic |
| C2 | 10nF 100VW polyester (10n/103k) |
| C3 | 220uF 16VW RB electrolytic |
| C4 | 4.7nF 100VW polyester (4n7/472) |
| C5 | 0.1uF 50VW ceramic (100n) |
| C6 | 100uF 16VW RB electrolytic |

### Semiconductors

| | |
|---|---|
| D1,D2 | 1N4148 or 1N914 small signal diode |
| D3 | 1N4007 power diode |
| Q1 | BUZ71 power MOSFET |
| IC1,2 | TLC555 or ICM7555 timer, CMOS |

### Miscellaneous

PC board, 62 x 33mm, code ZA-1201; momentary pushbutton switch; SPDT toggle switch, for power switching; battery snap lead; 20 x PCB terminal pins; hookup wire, solder, etc.

*Contined on page 117*

## Construction Project:

# DRY CELL CHARGER

In response to many reader requests, here at last is our dry cell and NiCad battery charger. It can charge various battery sizes, either a single cell or up to four in series. It also has its own 16 hour timer, and the multi-purpose LED indicator shows if the battery is actually taking a charge. It's also cheap and very easy to build.

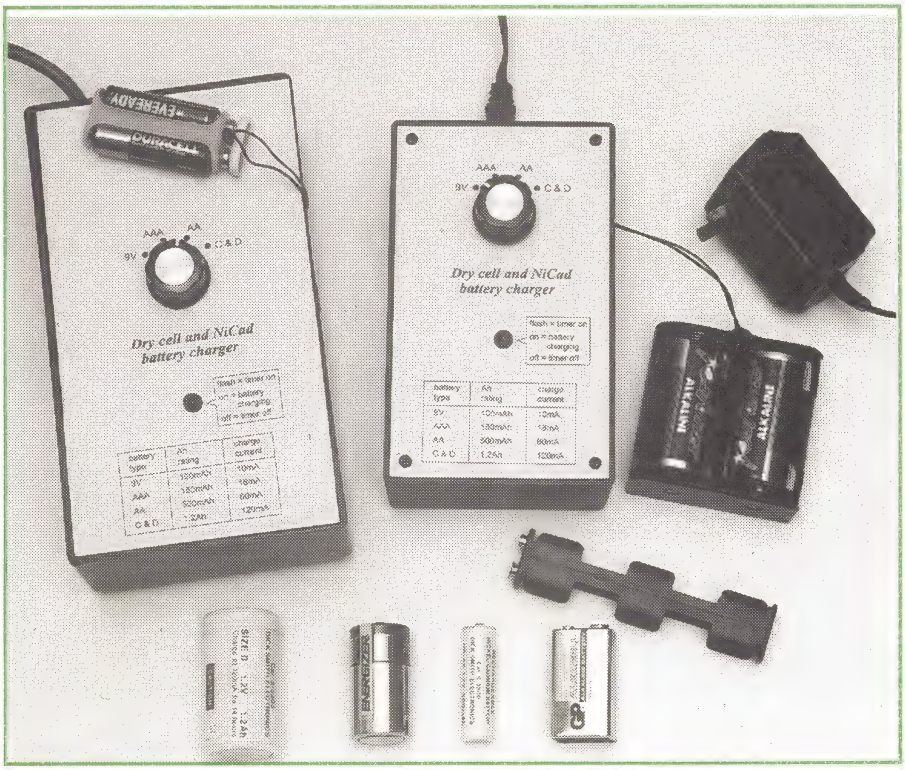
### by PETER PHILLIPS

This project is in response to the many requests we've had from readers for a dry cell charger. There's been a lot of publicity lately about such a device, following the release of a commercial unit called the Greencel charger. However, the principle behind a dry cell charger is not new — although this is the first fully featured dry cell charger circuit which has ever been presented in this magazine.

In fact, the history of recharging dry cells goes back quite a way. For instance, in December 1953, our predecessor *Radio and Hobbies* described a design for a portable valve radio featuring battery reactivation. In this circuit, the B battery could be 'recharged' from the mains using the receiver's 90V DC rail. However, the article presented the reactivation section as an option, highlighting the uncertainty whether a carbon-zinc dry cell could be recharged anyway.

Since then, *EA* has published a number of reader designs for dry cell chargers in the Circuit and Design Ideas section.

The British magazine *Practical Electronics* presented some basic designs for a dry cell charger in 1986 and discussed the pros and cons of recharging dry cells. You can now buy a commercial dry cell recharger, and no doubt there's more literature around on the topic. But, can a dry cell *really* be recharged?



***This dry cell charger can charge five different battery sizes and up to four cells in series. It will also charge the same size NiCad cells, and automatically switches off after 16 hours.***

## Dry cell recharging

From the tests we've been able to conduct so far, we can say this:

1. Dry cells can be recharged.
2. Alkaline cells respond to recharging far better than zinc-carbon cells.
3. There's a relationship between the amount of charge held by a dry cell after recharging and its original discharge voltage.

As well, we can say that the charger is also most effective at recharging NiCads, and may even rehabilitate an otherwise 'dead' NiCad. Next month we hope to publish more extensive details about dry cell recharging. We intend researching the topic by conducting a range of tests over a period of time, using various types of popular dry cells.

However, if you examine the fine print on the case of most dry cells, you'll find the statement 'do not recharge'. The cynically minded might suggest the manufacturer wants to sell more batteries. Another more practical view is that there really is a degree of danger in recharging a dry cell, just as there's danger in recharging any type of cell if it's done the wrong way. So what is the *right* way to recharge a dry cell?

## Operating principle

The basic principle of recharging a dry cell is borrowed from a technique used in electroplating. The idea is to pass a forward current (charging) through the cell, then to reverse the current so it discharges the cell. Obviously the charge current is larger than the discharge current.

Or put another way, the battery is charged with an alternating current that has a positive bias. A simple circuit that will do this is shown in Fig.1. On the positive half cycle diode D1 is forward biased, so current flows through the diode, R2 and the battery. The value of the charge current is therefore determined mainly by R2.

On the negative half cycle, the current flows in the opposite direction (discharge) and its value is now primarily determined by both R1 and R2 in series. Typically, the charge current is about four times higher than the discharge current.

## This charger

However, we need a bit more sophistication in a practical charger circuit compared to Fig.1. For starters, many people will want to charge a number of cells in series, rather than a single cell. As well, the charger should be able to handle a variety of cell sizes.

For the charger to accommodate a variable number of series-connected cells, we require a constant current source for both the charge and discharge currents. This way, the value of the current in either direction is independent of the number of cells.

Changing the value of the charge and discharge current can be done with a selector switch, and this charger is designed to handle 9V, AAA, AA and C or D sizes.

Two more useful additions to any charger are a multi-function LED indicator and a timer. This project has an inbuilt timer with a typical maximum delay of 16 hours.

The single LED indicator on the charger shows three things: clock rate to the timer (flashing), if the battery is actually being charged (fully on), and when charging is finished (off).

So, is there any danger in using this charger to recharge dry cells? We believe not, as the charge and discharge currents are limited to quite a low value, and there's a timer to turn the unit off after 16 hours. At no time during testing did a battery get hot, or even slightly warm as a result of being recharged. As well, there was no evidence of gases being generated, or of any stress on any of the dry cells tested with this charger. The value of the charge current for each of the four battery types is the same as the C10 rate typically used to charge a NiCad cell of the same capacity.

As already explained, the unit can also be used to charge NiCads. In fact, the biased AC method of recharging a NiCad is sometimes preferred to using DC, as it can remove dendrites that grow inside the battery. A dendrite is a thin thread of cadmium between the electrodes of a NiCad, usually caused by too much trickle charging.

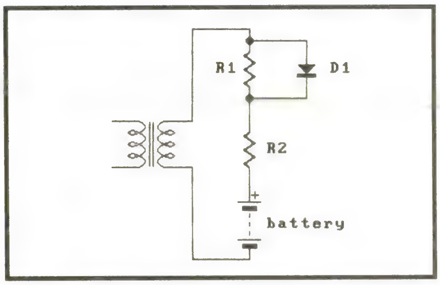


***Fig.1: This basic circuit gives a biased AC charge current, suitable for charging a dry cell. Charge current is limited by R2, the discharge current by R1 and R2 in series.***

But perhaps the most important feature of this charger is low cost. As you can see from the circuit diagram, there are no expensive or hard to get components. Construction is easy as everything fits on the one PCB.

A kit of parts will be available from Oatley Electronics, including a professional quality silk-screened PCB. Details and price are at the end of the article. Now let's look at how the circuit works.

## How it works

The incoming AC supplies the half wave rectifier circuit of D9 and C1. This voltage is regulated to 12V by R9 and Z1, and used to supply counter chip IC1. More on this counter later.

As we've explained, the battery is charged by a biased alternating current, with two constant current sources. On the positive half cycle of the AC input, D1 is forward biased, and assuming T1 is off, T2 will be forward biased by R3.

Collector current flows through T2, through the base-emitter junction of T3, turning T3 on and allowing charge current to flow through one of the emitter resistors R5-R8 (selected by SW1a) and the battery, via R10 and D10. The voltage developed across R10 and D10 forward biases T6, which turns on, lighting the LED.

This current also develops a voltage drop of around 0.6V, across the resistor selected by SW1a. It is this voltage that controls the regulating action of the constant current source, comprising T2, T3, R3, D3-5 and the resistor selected by SW1a. If the current increases, the voltage drop rises, turning off the transistors. A drop in the current causes a corresponding drop in the voltage, turning on the transistors harder.

Three diodes are needed in the base circuit of T2 — two to compensate for the base-emitter voltage of the transistors, and one for the 0.6V across the emitter resistor selected by SW1a. To compensate for temperature changes, diode D3 should be thermally bonded to the case of T3. This way, a change in the base-emitter voltage of T3 due to a change in its operating temperature is offset by a corresponding change in the voltage across D3.

The value of the charge current is therefore determined by the value of the resistance selected by SW1a, and is largely independent of the voltage of the battery being charged.

On the *negative* half cycle of the AC supply, D2 is forward biased, and current now flows in the reverse direction through the battery, discharging it. This current is about a quarter of the charge current, so a power transistor is not needed. The constant current source for the discharge current is formed by T5, D6, D7 and the resistor selected by SW1b. Its operation is as described before.

During this part of the cycle, the battery current now flows through R10 and D11, causing a voltage drop with a polarity that turns T6 and the LED off. However, while its brightness is reduced compared to being on continually, the LED appears on all the time, due the eye's persistence of vision.

Transistors T1 and T4 interface the timer to the constant current sources. When the timer output is low, T1 is held off, and T2 and T3 operate as already explained. When the timer switches high, T1 turns on, bypassing the base current for T2, holding it and T3 off.

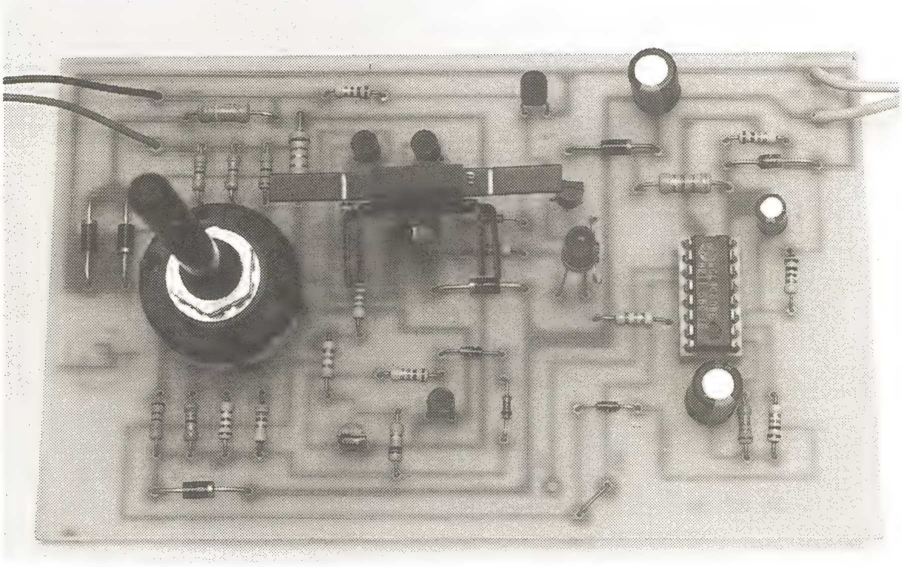
The operation of T4 is slightly different, as it is held *on* while the counter output is low, allowing base current to flow in T5. When the counter output is high, T4 and therefore T5 are held off.

A characteristic of this arrangement

**Table 1**

| battery type | NiCad Ah rating | charge current | discharge current | waveform 0-pk values across R10 | AC volts (approximate) |
|---|---|---|---|---|---|
| 9V | 100mAh | 25mA | 3mA | +100 / –12mV | 65mV |
| AAA | 180mAh | 68mA | 16mA | +265 / –65mV | 150mV |
| AA | 500mAh | 115mA | 28mA | +450 / –110mV | 250mV |
| C & D | 1.2Ah | 315mA | 60mA | +1260 / –220mV | 650mV |

# Dry Cell Charger



***This photo is a close up of the PCB. Notice the heatsink, which should be low enough not to touch the underside of the lid.***

is the change in the voltage across the two constant current sources with a change in the battery voltage. For the charge current regulator (T2-3), an increase in the battery voltage lowers the voltage across the regulator.

The opposite occurs for the discharge regulator (T5), in which the voltage drop increases as the battery voltage rises. While this doesn't have an appreciable effect on the value of the charge or discharge current, it affects the *time* the current flows for.

This means the charge time becomes less and the discharge time increases as the battery voltage is increased. For a 1.5V cell, the charge and discharge times are around 9ms and 11ms respectively. For a 6V pack of cells, the charge time is 7ms and the discharge time is 13ms.

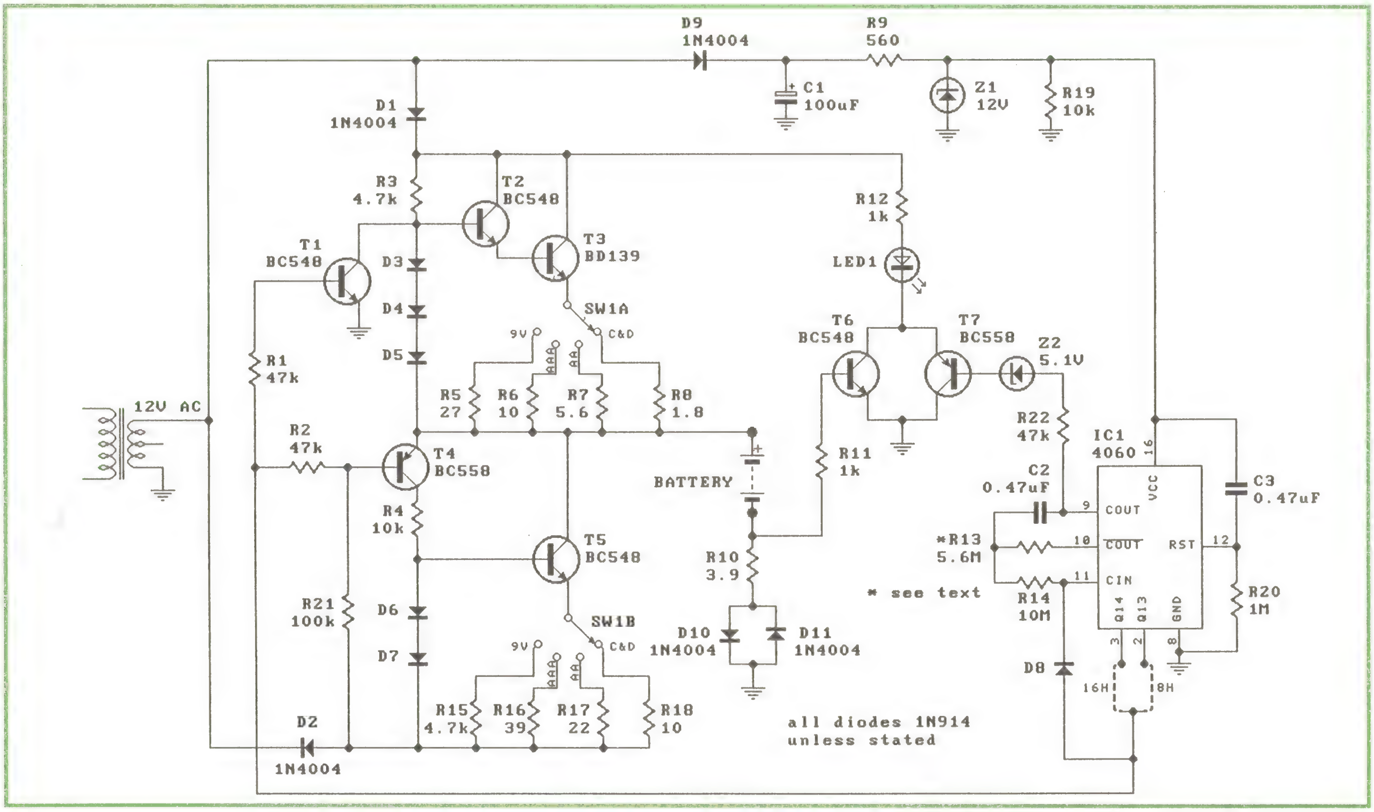
The values for the resistors selected by SW1 have therefore been chosen as a compromise to cater for a range of battery voltages up to 6V. Resistor R21 provides a small amount of forward bias to T4 so it can turn on when the battery voltage is less than one volt.

## The timer

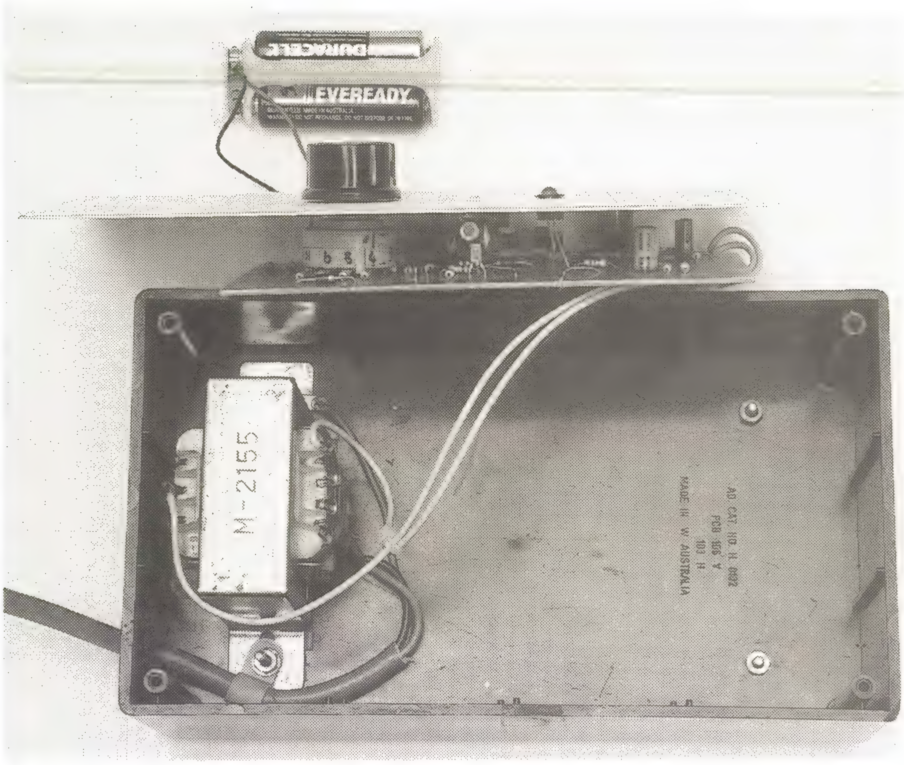
The timer circuit is about as simple as you'll get, considering it gives a delay of around 16 hours. It's based around IC1, a 4060 CMOS 14-stage counter. This IC also has an inbuilt oscillator that can be externally configured as either a crystal or an RC oscillator. We've used the RC configuration, as it's simpler, cheaper and quite sufficient for this application.

But, to get a 16 hour (or so) delay from a 14-stage counter requires a very low clock frequency. The mathematics to find this frequency go something like this:

The number of seconds in 16 hours is 16 x 60 x 60 = 57,600. The highest



***The charging constant current source (CCS) comprises R3, D#-5, T2, T3 and the resistor selected by SW1a. The discharge CCS comprises T5, D6-7 and the resistor selected by SW1b. Counter IC1 has a delay of 16 hours and switches off both current sources after this time.***



***As this photo shows, the charger can be powered by a transformer fitted inside the case. A larger size plastic box is needed, but take care with the 240V connections, and make sure the transformer is properly earthed.***

order output of the counter is Q14, which divides the input frequency by $2^{14}$ or 16,384. The input frequency of the counter's clock, for a total cycle time of 57,600 seconds at output Q14, is therefore 16,384/57,600, which is about 0.28Hz. However, this frequency gives a complete cycle at output Q14, in which the output is low for half the cycle, then switches high for the next half cycle. The charger circuit is designed so charging is stopped when output Q14 goes high, which means the *low time*, not the cycle time, must be 57,600 seconds. Therefore we need a further division by two, giving a clock frequency close to 0.14Hz.

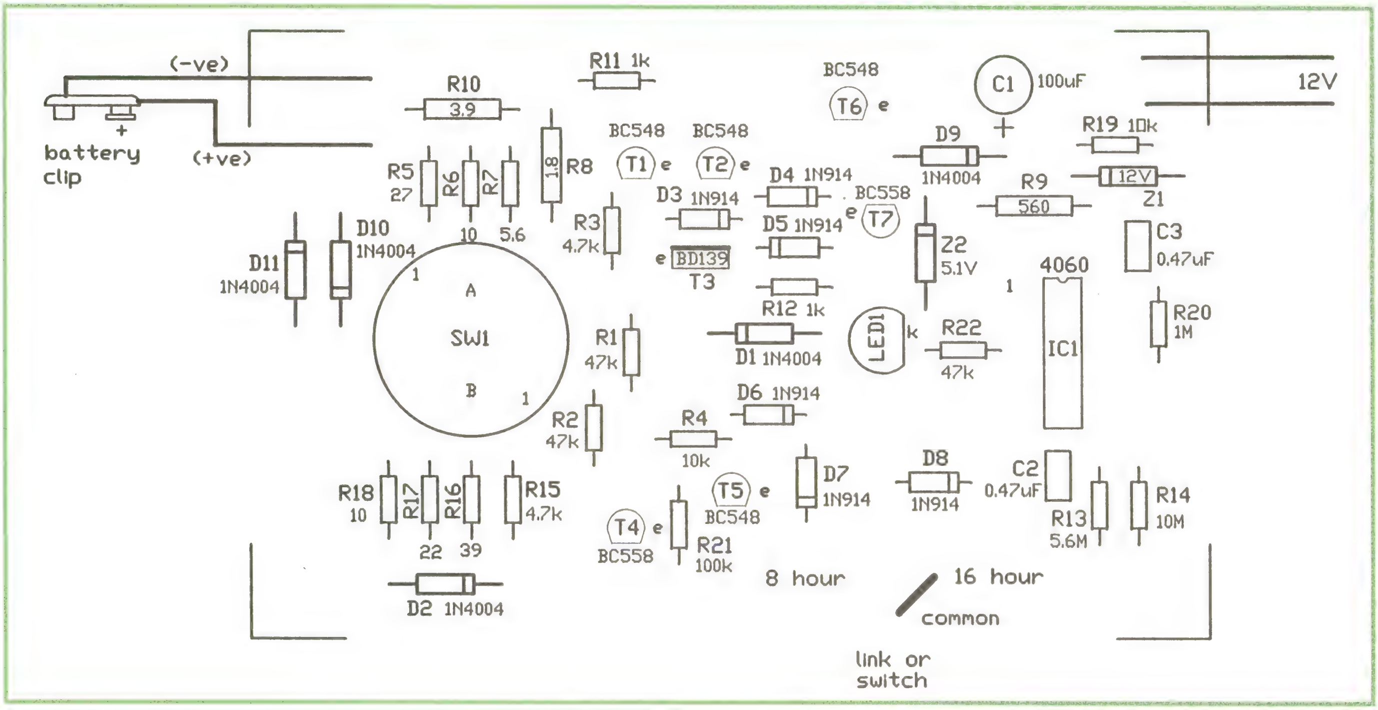
The counter is stopped after its time-out period, by feedback diode D8. When the counter output goes high, D8 is forward biased and holds the clock input high, disabling further counting.

The counter is reset by the voltage drop developed across R20, due to the charge current flowing through C3 when power is first applied to the circuit. This voltage momentarily sends the reset terminal (pin 12) high. Therefore to reset the timer, turn off the power, wait about 10 seconds, then switch the power back on.

## LED indicator

A frequency of 0.14Hz has a period of about seven seconds. A frequency this low is difficult if not impossible to measure using a 'scope or a frequency counter, but can be done quite easily with a stop watch. The most accurate way is to measure the time taken for 10 cycles, which in this case should be 70 seconds.

With this in mind, the indicator LED serves a dual role. When the charger is first turned on, the counter is reset as already described (cleared so all outputs are low). If a battery is connected to the charger, the LED will light via T6, indicating the battery is being charged. However, if the battery is disconnected, the LED will flash at the clock rate via T7. This transistor con-



***All circuit components fit on the PCB. This layout diagram shows where they go.***

## PARTS LIST

### Resistors

All 1/4W, 5% unless stated:

| | |
|---|---|
| R1,2,22 | 47k |
| R3,15 | 4.7k |
| R4,19 | 10k |
| R5 | 27 ohm |
| R6,18 | 10 ohm |
| R7 | 5.6 ohm |
| R8 | 2.2 ohm 1/2W |
| R9 | 560 ohm 1/2W |
| R10 | 3.9 ohm 1/2W |
| R11,12 | 1k |
| R13 | 5.6M (see text) |
| R14 | 10M |
| R16 | 39 ohm |
| R17 | 22 ohm |
| R20 | 1M |
| R21 | 100k |

### Capacitors

| | |
|---|---|
| C1 | 100uF 25V electrolytic |
| C2,3 | 0.47uF monolithic |

### Semiconductors

| | |
|---|---|
| D1,2,9,D10,11 | 1N4004 or similar diode |
| D3-8 | 1N914 or similar diode |
| Z1 | 12V 400mW zener |
| Z2 | 5.1V, 400mW zener |
| T1,2,5,6 | BC548 NPN transistor (or equiv) |
| T4,7 | BC558 PNP transistor (or equiv) |
| T3 | BD139 NPN power transistor (or equiv) |
| IC1 | 4060 CMOS 14-stage counter |
| LED1 | 5mm red LED |

### Miscellaneous

PCB coded BC/12/94 130 x 85mm; 2-pole 4-way PC mount wafer switch; 9V battery clip; 12V 300mA AC transformer, plug pack or conventional (type 2155) as required; plastic box to suit, size 50 x 90 x 150mm or 60 x 113 x 196mm; dial knob; plastic LED bezel; hook-up wire.

*Kits of parts for this projects are available from:*

***Oatley Electronics***
***5 Lansdowne Parade,***
***Oatley West, NSW 2223.***
*Phone (02) 579 4985*
*Fax (02) 579 3955*
*Postal address (mail orders):*
*PO Box 89, Oatley West NSW 2223.*

*Silk-screened solder-masked PCB ........ $9*
*PCB and all on-board components, including switch ................................ $24*
*Case (smaller size), knob, LED and adhesive front panel ............................ $7*
*Approved plug-pack 12V 300mA ......... $13*
*Packing & postage .............................. $4*

**Please note that this project is copyright to Oatley Electronics, and kits will not be available from other suppliers.**

nects to the clock input of the counter and the changing voltage at this terminal will alternately bias Z2 on and off, switching the transistor on and off. However, if T6 is on, T7 has no effect on the operation of the LED.

An indication of the clock frequency is useful for several reasons: it shows there's power to the charger, it proves the clock is working, and it gives you an easy way to check the clock frequency. The last reason is of most use when you first build the circuit. The frequency of the oscillator depends on the value of the timing components R13 and C2, and to a lesser extent on the value of R14.

Component tolerances need to be considered, and while an error of half an hour or so in the total time delay is quite acceptable, you will want to know whether the oscillator is running within this tolerance. To do this, check the period of the clock with a stop watch, measuring the time for 10 pulses of the LED.

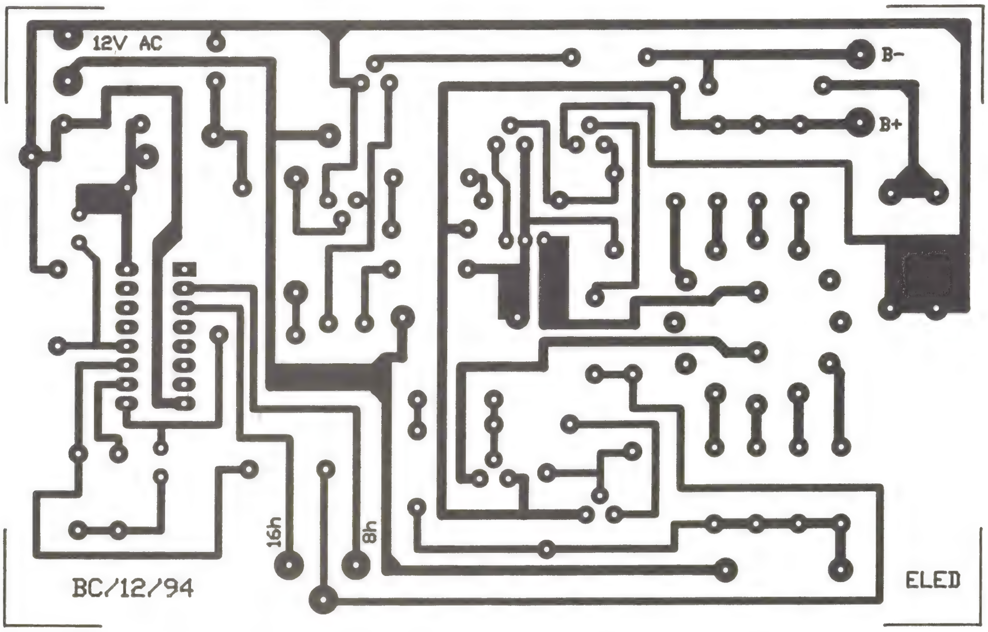
To determine the timer delay in hours, multiply the time for *one* clock cycle by 2.28. This constant is derived by dividing 3600 (seconds in an hour) into 8192 (number of clock cycles to change the state of Q14). For example, if 10 clock cycles take 74 seconds, the timer delay is 2.28 x 7.4, which gives 16.87 hours. A simpler way is to use a constant of 0.228 and the time taken for 10 clock cycles.

At this stage, we don't know the ideal time for charging a dry cell. We've selected 16 hours, on the basis that it typically takes 14 hours to charge a NiCad at the C10 rate. However, because this charger operates on a charge-discharge cycle, a longer time is needed. How *much* longer remains to be seen.

As well, because future research may show an eight-hour charge time for a dry cell is adequate, we've included a link on the PCB to select either of two outputs from the timer. A switch could also be fitted instead of a link.

## Construction

All the components mount on the one PCB, including the selector switch. The board layout is uncluttered, so construction should be easy, even if you are relatively new to electronics. Fit the 22 resistors first, making sure to use 1/2W rated resistors where specified. Next fit the diodes. Five of these are power diodes, so perhaps fit them first to avoid mixing the signal and power diodes. Then solder the six signal diodes in place, being sure all diodes are correctly polarised. Diode D3 should be fitted clear of the PCB by about 5mm, so it can be thermally bonded with heat sink compound to the BD139 transistor. Now fit the three



***The PCB pattern for this project is copyright to Oatley Electronics, but may be used by individual constructors who want to make their own board.***

# Electronics Books

***At last! References covering almost everything electronic for the hobbyist and trade professional. Learn how to troubleshoot, maintain and repair consumer equipment and design, build and test hundreds of projects from the most common to the obscure.***

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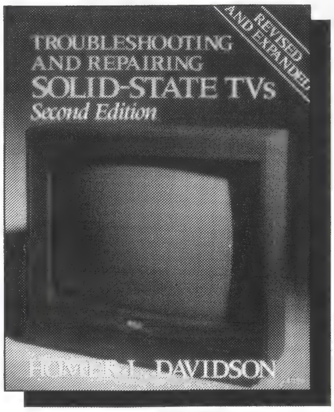

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*TAB/McGraw-Hill. 1992*

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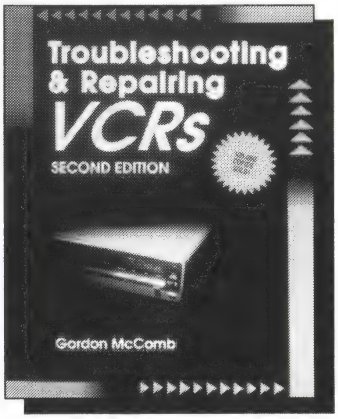

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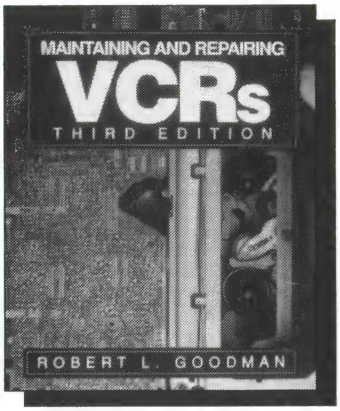

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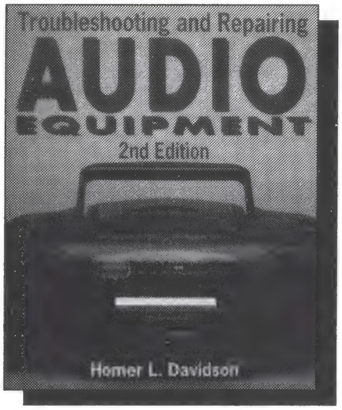

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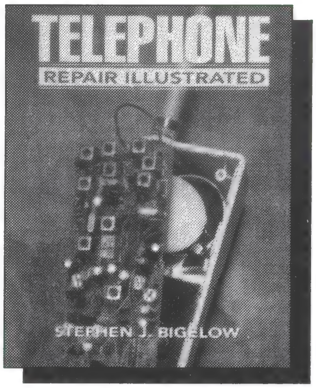

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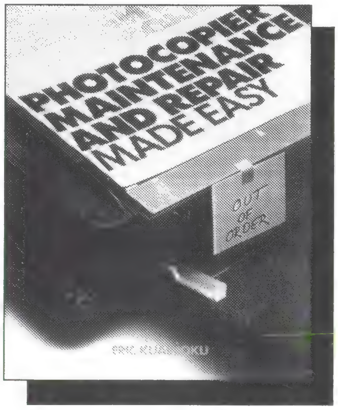

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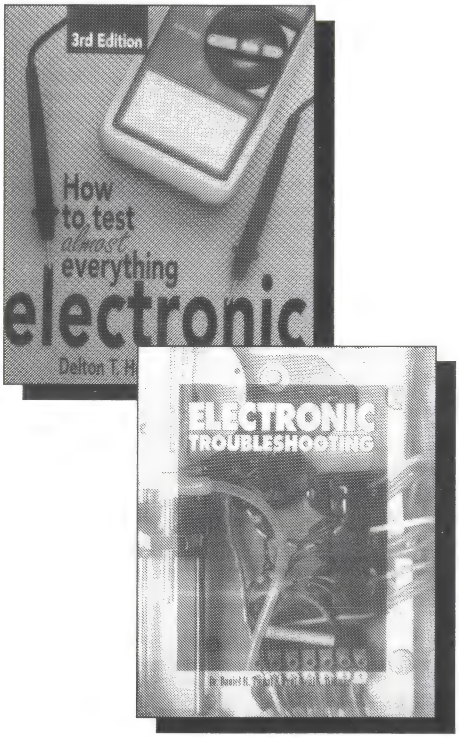
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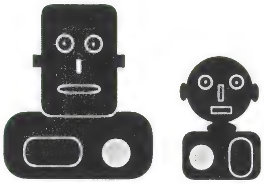

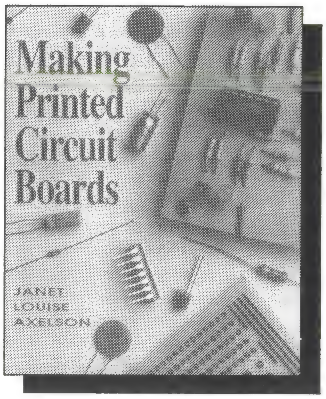

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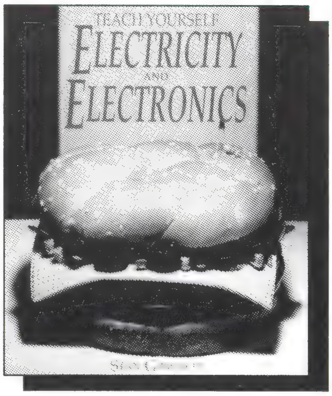

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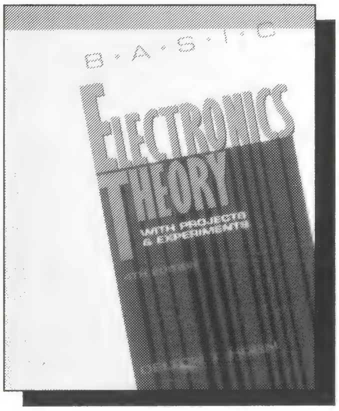

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capacitors and the two zener diodes, again checking their polarity before soldering them.

There are four BC548 (NPN) transistors, which all face the same way on the PCB. Solder these in place, then fit and solder the three BC558 (PNP) transistors. Transistor T7 faces the opposite way to all the others.

Fit a small heatsink before soldering T3 into the PCB. Because there's limited headroom, form the heatsink so it won't come into contact with the underside of the lid of the case. You can see the idea in the photo of the PCB.

When T3 is in place, put a small amount of heatsink compound on D3, and bend its leads so it's resting against the heatsink attached to T3. The heatsink compound will hold it in place and give sufficient heat transfer for D3 to act as a temperature compensator.

An IC socket for IC1 is optional. Either fit the socket now, or solder the IC in place. Then fit the LED, giving it sufficient lead length so it can poke through the hole in the lid.

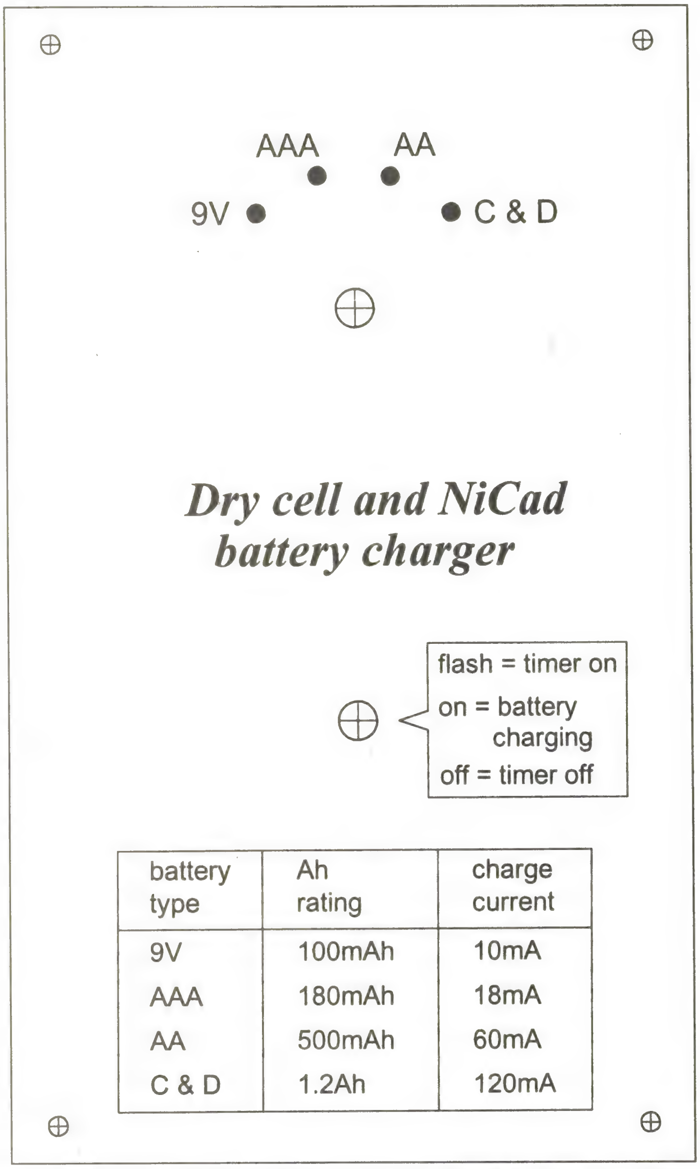
Finally, connect a 9V battery clip and either a socket to accept the 12V AC from a plugpack, or wires to any 12-15V AC source.

## Testing

When power is applied to the circuit, and there's no battery connected for charging, the LED should flash slowly. Remember the only way to reset the counter is to turn the power off, wait about 10 seconds, then switch the power back on.

Use the LED flashing rate to confirm that the clock frequency is reasonably correct. As already explained, use a stop watch to time how long it takes for 10 flashes of the LED. Then multiply this time by 0.228 to get the total time delay in hours. The aim is a time duration of around 16 hours, within 30 minutes or so. If you measure somewhere between 68 and 73 seconds, you are within a reasonable tolerance.

If the clock frequency is too fast (less than 68 seconds for 10 pulses), try a higher value for R13 (say 6.8M). To increase the speed of the oscillator, reduce the value of R13. Aim to err on the high side. That is, it's better for the clock frequency to be too slow to make sure you get at least a 16-hour time delay.



| battery type | Ah rating | charge current |
|---|---|---|
| 9V | 100mAh | 10mA |
| AAA | 180mAh | 18mA |
| AA | 500mAh | 60mA |
| C & D | 1.2Ah | 120mA |

***And finally, this is the front panel design used on the prototype. The fixing holes suit the smaller size plastic box.***

Next, check that the charge and discharge currents are correct for each range. If you have a 'scope, connect it across R10 to see the waveshape and values of the charge/discharge current. To convert the voltage reading to current, divide the peak values by 3.9.

For example, on the 9V setting, with a 9V battery connected to the charger, the peak positive voltage should be about 100mV, and the peak negative voltage about -12mV. This means a charge current of some 25mA and a discharge current of 3mA. The period of the charge waveform will be about half that of the discharge cycle.

You can also get a good idea if the current values are correct by reading the AC and/or the DC voltage across R10. Table 1 gives these and the peak values of the waveform across R10 for each type of battery. These values assume a single 1.5V cell — except for the 9V setting, which assumes a 9V battery.

It's important to check these values before committing the charger to service, just in case you've made a wiring error. For example, if you have either D3, D4 or D5 reversed, the charge current will not be controlled and could be high enough to cause the battery to overheat.

Or there might be something affecting the value of the discharge current. If so, the charger might discharge, rather than charge cells. It's worth checking first!

To do these checks, connect the charger to a single D-size cell. Use a 9V battery for the 9V setting. Also confirm that the LED stays on, rather than slowly flashing, when charging is occurring. You'll need to wait 16 hours or so to confirm that the LED is extinguished, indicating the charge sequence is finished.

Finally, set the tab on the selector switch so it operates over its first four positions. The tab for this is under the nut for the switch.

## Final assembly

As the photos show, you can power the charger with a 12V AC 300mA plug pack, or with a built-in transformer, type 2155. You'll need the larger size plastic box if you use an inbuilt transformer. However, we urge that only experienced constructors use a transformer, rather than a plug pack. Make sure you earth the transformer securely, and properly insulate the mains connections. Also, clamp the mains lead securely so it can't be accidentally pulled from its connections.

If you use a plug pack, either directly wire it to the PCB, or via a suitable socket to suit the plug pack connector.

*Continued on page 99*

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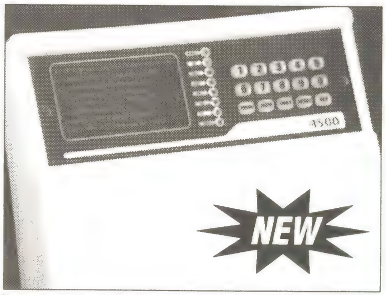

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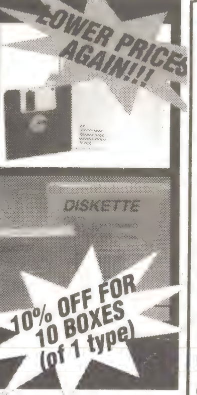
| | | | | |
|---|---|---|---|---|
| 3.5" | DSHD | Cat XC-4738 | $7.95 | was $9.95 |
| 3.5" | DSDD | Cat XC-4736 | $6.95 | was $7.95 |
| 3.5" | DSHD* | Cat XC-4739 | $8.50 | was $10.95 |
| 5.25" | DSDD | Cat XC-4730 | $4.50 | |
| 5.25" | DSHD | Cat XC-4732 | $6.95 | was $7.95 |
| 5.25" | DSHD* | Cat XC-4733 | $7.50 | was $9.50 |

* denotes "IBM FORMATTED"

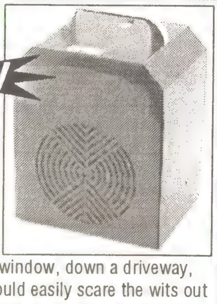


10% OFF FOR 10 BOXES (of 1 type)

## ELECTRONIC WATCHDOG BARGAIN

NEW

We've made a scoop purchase of a more expensive unit which normally sells for $199. We are selling these at the price of the cheaper unit - $139.50. The electronic watchdog incorporates a microwave motion sensor which activates when it detects movement and then it starts barking. It barks for 5 seconds each time it is triggered and barks continually if there is constant movement. The Watchdog is best mounted about 1.5mt high. Its surveillance distance is 6-8 metres. Because it's microwave, it will detect through any obstacle so it can safely look through a window, down a driveway, across a verandah, etc. The sound is very authentic and would easily scare the wits out of an intruder. The unit is housed in a metal box with a handle on the top. It operates from 240V through a plugpack (supplied) and has a volume control and a range control. Call into any store for a demo.



**Cat. LA-5280** **$139.50** **save $60**

DOLBY SURROUND PRO • LOGIC

# SURROUND SOUND KIT

## ANOTHER JAYCAR EXCLUSIVE

REFER SILICON CHIP MAGAZINE DECEMBER 1994

Jaycar are proud to announce the "KIT OF THE DECADE". An enormous amount of effort has gone into this project by staff at both Jaycar and Silicon Chip. Up until now, if you want Dolby Pro Logic it will cost you at least $500. Now you can have it for less than half that. You will have to assemble the kit though. The kit will give you amazing cinema sound in your home. You will need a Hi Fi VCR or any other source of a stereo soundtrack ie Stereo TV, Laser Disk, Cable or Satellite signal and of course an amplifier for the centre and rear channels.

**The kit is approved by Dolby Laboratories (USA), and is the only kit currently available in the world for a Dolby Pro Logic Surround Sound Decoder.**

NEW

### SHORT FORM KIT

PCB and all on board components including Dolby chips, switches, potentiometers & RCA sockets.

**Cat. KC-5175 ONLY $169.50**

### PUT IT IN AN ENCLOSURE KIT

Includes everything to complete the kit - box, punched and screened front panel, punched rear panel with label, torroidal mains transformer, mains switch, mains lead and plug and 4 knobs.

**Cat. KC-5176 ONLY $69.50**

**TOTAL ONLY $239.00**

CAR ELECTRONICS JAYCAR ELECTRONICS JAYCAR ELECTRONICS JAYCAR ELECTRONICS JAYCAR ELECTRONICS
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## ••••••PROFESSIONAL QUALITY REFERENCE SERIES RCA LEADS AND PLUGS•••••••

If you want the **VERY BEST** quality in RCA audio leads for car Hi Fi, or Home Hi Fi - look no further. These REFERENCE SERIES leads use OFC double shielded low capacitance cable with a central lead wire for remote switching of car amps, or for extra grounding on Home Hi Fi. Cable is figure 8 OFC blue colur with OD of 5mm per side. Plugs are superb quality gold with nickel metal covers - colour coded red/black.

**UPGRADE YOUR HI FI's "LIFELINE"**

**LEADS - 2 X RCA TO 2 X RCA**

| CAT | LENGTH | PRICE |
|---|---|---|
| WA-1060 | 0.5 metres | $19.95 |
| WA-1062 | 1.5 metres | $24.95 |
| WA-1066 | 5.0 metres | $34.95 |

**PLUGS** (Plugs only with 6mm cable entry)

| CAT | COLOUR | PRICE |
|---|---|---|
| PP-0230 | Red | $4.50 |
| PP-0232 | Black | $4.50 |

**INSTALLERS / MANUFACTURERS - CONTACT OUR WHOLESALE DEPT FOR BULK PRICES**

## MASSIVE TORQUE 12V MOTOR/GEARBOX

BRAND NEW STOCK - MASSIVE SCOOP PURCHASE

Jaycar has secured a small quantity of the quality Japanese made MABUCHI FK-280SA 12VDC motor. This motor (on its own) develops good torque but when coupled to the step down gearbox supplied the torque is up to a massive 9,000 grams/cm - thats right 9 kilograms/cm! The motor is supplied with the high quality 50:1 ratio gearbox fitted. M3 screws (not supplied) bulkhead mount the whole assembly securely. Gearbox output shaft is 6mm dia (25% flat) hardened steel 27mm long. You can remove the gearbox from the motor. The motor has a 6mm dia 12 tooth gear pressed into the shaft. The motor can be bulkhead mounted with 2mm metric screws.

We cannot emphasize the quality of such a product. Output speed ranges from 100RPM downwards depending on the load. Under a typical load the output shaft would be expected to work at about 90RPM.

Each motor is supplied with electrical / mechanical / dimensional data. The motor / gearbox set has thousands of uses and is offered far, far below normal retail. Its the old story - the distressed supplier lost money on the deal and we are passing the savings on to you!!

Be quick as a product like this never lasts long on our shelves.

Dimensions - Body length 52mm, Body dia 37mm, Overall (inc shaft) 73mm

**Cat. YM-2702** **only $19.95 each**

## IC EXTRACTOR WITH TWO SECURER TABS

This extractor is unique in its operation in as much as it has 2 securer tabs with springs which grasp the IC and hold it after it has been removed. Suitable for IC's 8-28 pins. Length 105mm.

NEW

**Cat. TH-1819** **$3.95 each**

## BARGAIN PIR's FOR USE WITH OUR NEW 4500 FOUR SECTOR PANEL

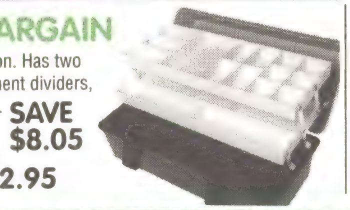
## BELLMATE 100 PULSE COUNT PIR's SLASHED

Thousands sold. Our most reliable and popular PIR ever!!! See 94 catalogue for full details.

**Cat. LA-5016 Normally $49.95**

**Now $39.95 Save $10**

## LARGE TOOLBOX BARGAIN



Ideal for the professional or tradesperson. Has two fold-out trays with adjustable compartment dividers, twin locking clips and twin carry handle.

Size 415(L) x 160(H) x 170(D)mm

Tray size 375(L) x 155(W) x 28(D)mm

**SAVE $8.05**

**Cat. HB-6332** **NOW $22.95**

## Low Cost Temperature Controlled Soldering Iron

**SAVE $10**

Ideal hobbyist soldering station. It operates on 240 volts, and the transformer delivers a safe 16 volts to the soldering iron.

It has a PTC (Positive Temperature Coefficient) soldering tip at a constant temperature of 310°C which is ideal for PC work. It has a 20 second heatup time.

Replacement Tip Cat TS1202 $9.95

**Cat. TS-1200 WAS $49.95**

**NOW $39.95**

**SAVE $10**

## AMAZING CASE

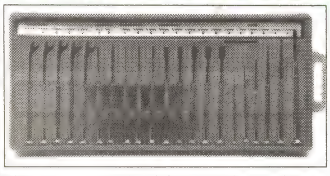
Another surplus stock purchase with a limited number available. This case is real quality and was used for a satellite receiver, and were left over when the production ended. Its made with 1.5mm steel, which has been black anodised. The chassis base includes a sub front panel and a separate front panel is also supplied. There are two rectangular holes, which were used for LED displays. They measure 17(W) x 19(H)mm and 30(W) x 19(H)mm. There are two round holes on the right - dia 5.5mm. There is a piece of perspex also supplied which neatly fits in the front panel slots to cover the LED display holes. Perspex size is 340(W) x 25(H)mm.

It is vented at the top rear, bottom rear and underneath the front panel where the case is chamfered. The internal height for most of the case except near the sides is 76mm. Width is 430mm and depth is 345mm. There is no rear panel, you could use one of our 88mm rack panels for this, we have non conforming panels (Cat HB-5422 only $7).

With the 88mm panel mounted on the rear, the box could be turned around and the rear becomes the front. The uses are endless. You could mount our new Dolby Pro Logic kits in the case for a really professional finish.

**Cat. HB-5360** **only $25**

## 21 PIECE PRECISION SCREW DRIVER SET



NEW

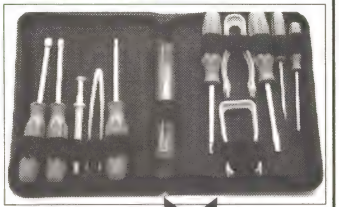
New model for 95!!!. Now has 21 pcs for the same price as the old 15 piece set.

Includes:

Slotted s/drivers (6) - 0.9, 1.2, 1.8, 2.4, 3.0, 3.5mm
Philips screwdrivers (2) - #0 & #1
Hex screwdrivers (3) - 1.5, 2.0, 2.5mm
Nut drivers (5) - 3.0, 3.5, 4.0, 4.5, 5.0mm
Mini spanners (5) - 4.0, 4.5, 5.0, 5.5, 6.0mm All housed in a plastic case.

**Cat. TD-2003** **ONLY $14.95**

## COMPUTER SERVICE TOOL KIT



NEW LOW PRICE!!!

We have been selling these for $39.95. We've direct imported them from the manufacturer and have been able to reduce our price to $24.95.

Kit Includes:

•IC inserter •IC extractor with securers •Pin vice •Tweezers •1/4" nut screwdriver •3/16" nut screwdriver •T15 torx screwdriver •parts tube for storage •#1 Philips screwdriver •3/16" slotted screwdriver •#0 Philips screwdriver •1/8" slotted screwdriver •Zipper case •Size 220 x 155 x 38mm

NEW

**Cat. TD-2040** **$24.95** **save $13**

## CLEAN UP THAT WORKBENCH

Designed to hold all your "bits & pieces":- resistors, capacitors, semiconductors, drill bits, nuts & bolts, nails, etc. The unit is grey with clear drawers. There are key holes in the rear for easy wall mounting. Drawers have a stopper so when pulled out they won't come all the way out spilling your components. Each drawer will accept up to 3 plastic dividers which can divide the drawer into 2, 3 or 4 separate compartments. 16 drawer dividers are supplied.

Drawer size 110(L) x 50(W) x 34(D)mm Total size 185(H) x 242(W) x 124(D)mm

**Save $23.70**

**Cat. HB-6320** **was $14.95 Jan Special 6 for $66**

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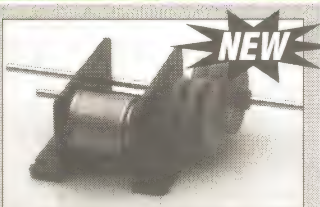
## MOTOR / GEARBOX KIT

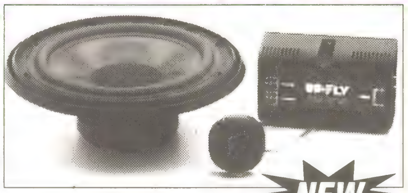


**BRAND NEW MODEL!!!**
This brand new gearbox enables you to simply create a gearbox with the following ratios 4:1, 16:1, 64:1, 256:1,1024:1 and 4096:1.
This equates to 3379, 845, 211,53,13.2 and 3.3RPM at a motor speed of 3VDC (note motor is supplied). As you can imagine the torque at the low output speeds is massive!!
You can alter the speed upward by about 50% by increasing the motor voltage to about 4.5VDC and down by the same percentage to 1.5VDC (these figures are approximate). The gearbox is supplied in knocked down form, ready for assembly to the configuration you require. Instructions are supplied. The output shafts (intermediate and final) are 3mm dia hardened steel. The final shaft protrudes from both sides of the gearbox. Dimensions: •motor cage - 53 x 50 x 30mm high •gearbox cluster - 27 x 40mm •main shaft - 100mm •intermediate shaft - 70mm.
PLEASE NOTE THAT THIS PRICE INCLUDES 3V MOTOR

**Cat. YG-2715** **$27.95**

NEW

## CAR SPEAKER KIT



We don't think the manufacturer could have picked a worst name if they had tried. The brand is UPFLY. But don't let that alter your assessment of the product. They are NOT made in China, but Taiwan. Taiwan is now making very good quality speakers. These are actually a second brand label for a large OEM who we all know but we can't say who.
The system consists of 6.5" woofer, and a Neodidyium Super Tweeter with a high power crossover. They handle high power, so require a power amp of at least 30WRMS per channel to drive them properly. 10 watts is not enough!
SPECIFICATIONS:
•Power handling - 80WRMS •Impedance - 4 ohms •Freq resp - 40 to 22,000Hz •Sound pressure level - 90dB •Woofer - 6.5" with treated paper cone and rubber surround, magnet weight - 10 ounce, voice coil dia 25mm •Tweeter - Super tweeter with surface mount design. Small size with great response •Crossovers - High power units with crossover frequency of 2500Hz. Each housed in its own case. Supplied with metal grills for woofer and mounting screws/cables etc. A quality set of speakers that will give you years of excellent service. Add to this a Subwoofer tube for excellent car Hi Fi sound.

NEW

**Cat CS-2275** **$199.50 pair**

## TWO WAY HI FI MINI MONITORS

Ideal Dolby Surround Rear Speakers

These mini speakers sound fabulous. They have a 3.5" woofer and 2" soft dome tweeter in a bass reflex enclosure, which is made from ABS plastic. They are supplied with steel mounting brackets and have a black metal grill over the speakers. They are ideal for bookshelf speakers, extension speakers for TV and most importantly are ideal for Dolby Surround rear speakers. SPECIFICATIONS:
•Woofer - 3.5" doped paper cone 8oz magnet •Tweeter - 2" soft dome 5.3oz magnet •Power handling - 35WRMS •Impedance - 8 ohm •Sensitivity - 89dB •Freq response - 60Hz to 20kHz •1.4kgs each •Dims - 185(H)x117(W)x112(D)mm

NEW

ANOTHER JAYCAR BARGAIN

**Cat. CS-2428** **$119.50 pair**

## NEW BATTERIES

### COMPUTER BATTERIES - 3.6V LITHIUM

As used in most PC's. Don't pay $15 anymore!
Supplied with PC mount Pins.
Specifications: •Operating voltage - 3.6 to 3.7V •Termination voltage - 2.5v •Capacity - 0.6AH •Temperature - minus 40°C to plus 85° Celcius •Storage period - 10 years. •Dimensions - 25(W) x 14(Dia)mm.

NEW

**Cat. SB-2540** **$9.95**

### THIN 12V ALKALINE REMOTE BATTERY

These are used in the new style car alarm remote controls. They measure 8mm dia x 28mm high.

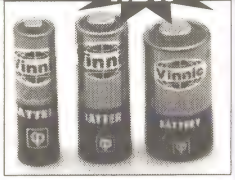
**Cat. SB-2422** **$2.20 each**

### 6V ALKALINE

These are the same size as A544 batteries. Used mainly in cameras. Size 13mm dia x 25mm high.

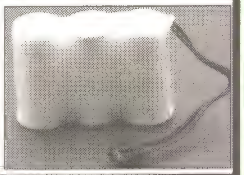
**Cat. SB-2415** **$2.50 each**

NEW



left to right - SB2422 / Common Remote Battery / SB2415

### CORDLESS PHONE BATTERY

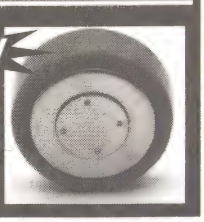


This is a bank of three batteries next to each other. Size is 30(H) x 14(W) x 41(L)mm. Voltage is 3.6V. Current is 270mA. Supplied with lead and 2 pin Mitsumi plug. Used on Uniden & James Hardie phones.

**Cat. SB-2476** **$17.95 each**

### NICAD BUTTON CELL

NEW



Make up your own nicad pack. As used in many packs for Cordless Telephones etc. Specifications: •Generic battery # - N280BC •Capacity - 280mAh •Voltage - 1.2V •Size - 25(Dia) x 8.8(H)mm •Standard charge - 15hrs at 28mA •Quick charge - 3hrs at 140mA •Connection contacts - solder tags

**Cat. SB-2470** **$2.95ea**

## ALKALINE BATTERY CHARGER

### PROLONG THE USE OF YOUR ALKALINE AND ZINC CARBON BATTERIES WITH THIS CHARGER

NEW

This NEW "OMEGA" intelli - charger will charge alkaline, nickel cadmium, zinc carbon and alkaline manganese batteries in sizes AA, AAA, C and D.

**SAVE MONEY BY RECHARGING INSTEAD OF THROWING AWAY!!!**

Up until now, these new generation chargers have cost around $90. We feel that this high price makes the proposition quite marginal. It will take a long time to recoup the cost of the charger because its so high.

**ALL THAT HAS CHANGED WITH THIS UNIT!!!**

The "Omega" has a built in microprocessor which monitors the charging of each battery. Three different coloured LEDs advise you if: •The battery is charging normally •The charger has rejected the battery, or the battery is reversed •The battery is charged and ready to use
There is no chance of overcharging the batteries, as the unit automatically shuts down each battery compartment when its battery is charged.
Please note: Batteries should not be totally discharged before recharging.

**DON'T PAY $90......OUR IS ONLY $39.95**

AC adaptor is extra - unit requires 9VDC at 800mA. Use your existing one, or purchase one separately...Cat MP3008 $22.95

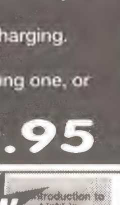
**Cat. MB-3525** **Only $39.95**

**ALL JAYCAR PRODUCTS AVAILABLE AT WHOLESALE PRICES TO RESELLERS, MANUFACTURERS, BULK USERS ETC.**

## NEW BABANI BOOKS

### Introduction to Light In Electronics

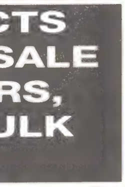
NEW



Taken for granted by us all perhaps, yet this book could not be read without it. We appreciate its existance, but how much do we understand it? Chapter headings include: •Fundamentals first •Waves and particles •The nature of light •Measurement •Lights in action •Light devices •Lasers •Fibre optics •Reminders.The book has been written with the general elec enthusiast in mind, not the expert. Softcover - 164 pages - 110x178mm

**Cat. BB-7037** **$13.95**

### Practical Electronic Musical Effects Units



Provides practical circuits for a number of electronic musical effects units. Many can be constructed for much less than the cost of equiv ready made units. Projects: •Waa waa •Distortion •Phaser •Guitar envelope shaper •Compressor •Tremelo unit •Metal effects unit •Bass and treble boosters •Graphic equaliser •Parametric equaliser. Most of these projects are within the capabilities of the average electronics hobbyist and none require test equipment to get them going. Several suit near beginners. Softcover - 102 pages - 110 x 178mm

NEW

**Cat. BB-7038** **$13.95**

# L A ACOUSTIK CAR ALARMS

## LA ACOUSTIK CAR ALARMS REPRESENT THE VERY LATEST INNOVATIONS IN CAR SECURITY

**NEW** **$169**

**LA-8901**

There are two models available - both have the following features:

- •REMOTE CONTROL ARM/DISARM
- •COMPLETE VEHICLE PROTECTION - Detects & sounds an alarm if any attempt is made to open the boot, bonnet or doors. If the vehicle is hit, windows broken, jacked up or towed the alarm will sound. The vehicles lights will flash and the ignition will be switched off.
- •AUTOMATIC ENGINE KILL - Should a thief gain access to the vehicle, stops the engine from starting, even with a key.
- •LONG RANGE REMOTE CONTROL - Can be used within a 100 metre range.
- •VEHICLE NOT SECURE WARNING - If a door is not properly closed when the alarm is activated, the system will sound an alarm to advise the driver to close the door properly.
- •REMOTE CONTROL LOCK/UNLOCK - The push button remote control locks/unlocks doors if central locking is fitted.
- •EMERGENCY PANIC SYSTEM - If either you or your vehicle are in threat hold down the off button on your remote to trigger the alarm to scare the thief away. The car can also be protected from "car hi-jacking" by pressing the off button for 2 seconds. This will firstly cause the alarm to sound and 15 seconds later the ignition will cut out.
- •DOUBLE PROTECTION - If the alarm is on, and the off button is accidentally pushed, the unit will automatically re-arm itself after 30 seconds.
- •AUTO DOOR/LOCKING- If you have central door locking connected, the unit will automatically lock the doors when the engine is started, and unlock them when its switched off. This prevents children from opening doors while mobile as well as assaults when stopped at traffic lights.
- •ALARM MEMORY REPORT - After disarming, the system will report any attempted break-ins.
  - Siren sounds once - normal operation.
  - Siren sounds three times - vibration sensor has been triggered.
  - Siren sound four times - a door has been opened.
  - Siren sound five times - ignition switch has been used.
- •SMART SHOCK SENSOR - This device can distinguish between light and heavy shock levels. A light shock will quickly pulse the siren warning people not to touch. If a heavy shock is sensed the alarm will sound for 30 seconds.

**ANOTHER JAYCAR EXCLUSIVE** **$199**

**LA-8904**

### LA ACOUSTIK LA-8901 WHAT YOU GET:

•Black box electronic module with all the above features •2 transmitter key fobs •ignition cut out relay •flashing dash light •shock sensor •wiring (note that more difficult installations may require more cabling)

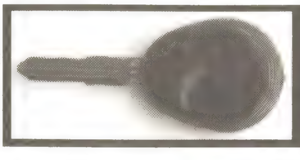
**Cat. LA-8901** **$169.00** ★★★★★★★★

Siren Options - You will require one of the sirens shown below:

### LA ACOUSTIK LA-8904 ADDITIONAL FEATURES:

•SPECIAL KEY FOB TRANSMITTERS - In which you can mount your car key. Simply cut your key and drill two holes. Mount the key and your transmitter and key become one!

•AUTOMATIC BOOT OPENER - Fit a solenoid to the boot and you can open the boot using the remote controller. Great if you have both hands full. (Solenoid Cat LR-8833)



SPECIAL KEY FOB TRANSMITTERS
In which you can mount you car key. Simply cut your key and drill two holes. Mount the key and your transmitter and key become one!
AVAILABLE ONLY WITH THE LA-8904

**WHAT YOU GET**

•Black box electronic module with all the above features •2 key mountable key fobs remote controls •ignition cut out relay •flashing dash light •shock sensor •wiring (note that more difficult installations may require more cabling)

**Cat. LA-8904** **$199.00**

### Siren Options For Both The Above Systems

You will require one of the following:

Normal siren horn
**Cat LA-8908**
**$24.95**

Backup battery siren horn
**Cat LA-8910**
**$62.95**

**BUY 10 LESS 10%**

## 4 Door Car Power Door Lock Kit

If you own a 4 door car and want the convenience of power door locking, this is the kit for you. It consists of 2 master solenoids and 2 remote solenoids. (Masters for the front doors, so opening either will unlock the other 3 doors). Full wiring harness to connect all 4 solenoids to the doors of even the biggest cars, all hardware. Also inc is the controller relay circuit (Cat. LR-8835 $29.95).

**Cat. LR-8830 normally $119.50**

**NOW $95 SAVE $24.50**

## THE LATEST KITS

| | | | |
|---|---|---|---|
| Clifford the cricket | SC 12/94 | KC-5178 | $12.95 |
| 80M DSB amateur rig | SC 11/94 | KC-5177 | $59.95 |
| Pro logic enclosure kit | SC 12/94 | KC-5176 | $69.50 |
| Dolby Pro logi s/form | SC 12/94 | KC-5175 | $169.50 |
| 3 spot sine wave oscillator | SC 12/94 | KC-5174 | $59.95 |
| Talking headlight reminder | SC 10.94 | KC-5173 | $59.95 |
| Minivox voice op kit | SC 9/94 | KC-5172 | $14.95 |
| Auto nicad discharger | SC 9/94 | KC-5171 | $27.95 |
| Twin diversity FM receiver | SC 9/94 | KC-5170 | $199.00 |
| LW AM weather receiver | SC 9/94 | KC-5169 | $32.95 |

| | | | |
|---|---|---|---|
| Hi power dimmer s/form | SCV 8/94 | KC-5168 | $47.95 |
| Nicad zapper | SC 8/94 | KC-5167 | $29.95 |
| Pre Champ pre amp | SC 7/94 | KC-5166 | $7.95 |
| Steam whistle & diesal | SC 7/94 | KC-5165 | $22.95 |
| 6V SLA battery charger | SC 7/94 | KC-5164 | $29.95 |
| Shoestring amp | EA 12/94 | KA-1767 | $129.00 |
| Cable checker | EA 11/94 | KA-1766 | $22.95 |
| Active subwoofer x/over s/f | EA 9/94 | KA-1765 | $29.95 |
| Active subwoofer x/over | EA 9/94 | KA-1764 | $69.95 |
| Temperature controller | EA 8/94 | KA-1763 | $44.95 |
| Screen saver | EA 6/94 | KA-1762 | $14.95 |

**Jaycar ELECTRONICS**

**HEAD OFFICE**
6 LEEDS ST RHODES 2138
PHONE: (02) 743 5222
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## Construction Project:

# VALVE PREAMP FOR AUDIOPHILES - 2

In this second article describing an interesting new design for a high-quality stereo preamplifier using valves, the author covers its construction and setup. All parts necessary to make the preamp are available as a kit from Contan Audio, with various options to suit individual needs. As explained later, Contan can also supply individual components if required.

### by TEAN TAN

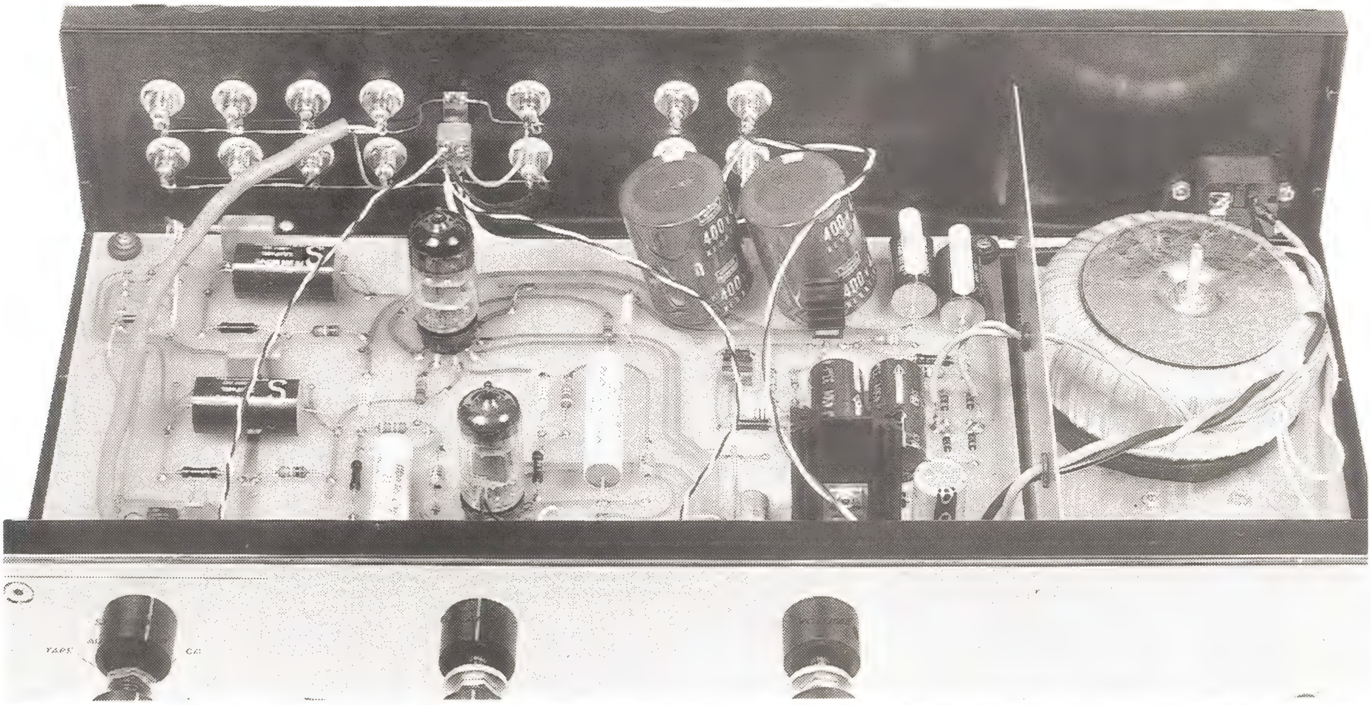
This preamplifier is easier to build than our power amplifier, the Stereo Eighty, which was based on EL34 valves (*EA*, October-November 1992). However like most valve preamps based on the common cathode/cathode follower configuration, it's still not entirely straightforward. For example this design has the B+ (high tension) supply regulated, and the amplifier outputs have a timer circuit to protect the speaker.

As a result, it's important that constructors take the necessary precautions to ensure that constructing this project is successful. There are two areas that should be mentioned, one involving your own safety and the other the soldering and wiring techniques used to make the project itself.

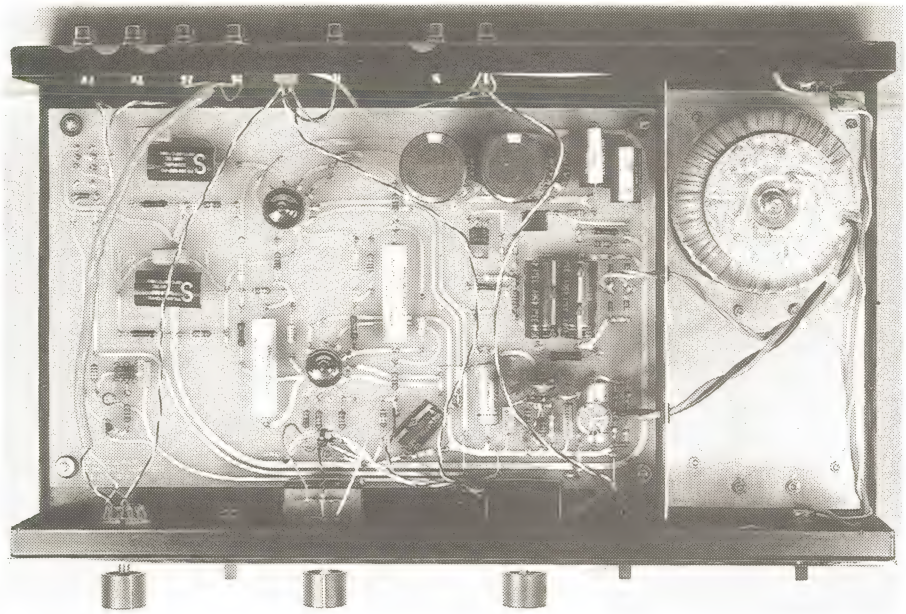
## Safety precautions

We can't emphasise too much that because of the high voltages present in a valve project of this type (300V DC as well as 240V AC from the mains), constructors should take the necessary safety precautions. Accidental contact with these high voltages will cause a nasty shock, and could even by fatal — so please be **very careful**. Recommended precautions to take include the following:

1. The mains earth should be connected to the chassis in a reliable and secure fashion, as described later. Make sure that you produce a secure earth connection by scraping off the paint from the metal under the solder lug, so there's a good metal-to-metal contact. The chassis ground is connected to the 0V line on the PCB. Refer to the wiring diagram for details.
2. A correct fuse (500mA slow blow) must be used, inserted in the IEC socket fuse holder.
3. Use only one hand when measuring any voltages — preferably the right hand. The left hand should not be touching any part of the PCB, or metalwork. The common terminal of the multimeter should be connected to the chassis ground using an alligator clip jumper lead.
4. Switch off the amplifier before



*This view inside the preamp case gives a good idea of the internal layout, and also the way the components are fitted to the copper side of the main PCB. Not all of the input connector wiring was in place when this photo was taken.*



**An overall view of the preamp internals. The toroidal power transformer at upper right is mounted on an L-shaped shield plate, as explained in the text.**

making any adjustment — e.g., when changing components or resoldering.

5. Do not plug in any valve while the power is on. Always turn the power off first, and preferably allow the capacitors to discharge by waiting say 30 seconds before plugging in the valve.
6. Do not make any measurements of voltages, etc., inside the preamp without wearing suitable footwear, such as rubber or dry leather shoes.

Here are some other suggestions we'd like to make, regarding the steps to take when you're building the preamp, in order to minimise problems and ensure success:

A. The kit is supplied with a large PCB which accommodates all of the electronic components. Prior to soldering, perform a stocktake and make sure you have all of the parts needed.

B. Note that the components should be soldered on the same side as the copper tracks. The preamp has been designed this way so that the components can be installed or removed easily without turning over the PCB. This enables the constructor to experiment with the different components — e.g., resistors, capacitors and valves. The only component mounted under the board, on the non-copper side, is the muting relay.

C. Ensure that polarised parts such as diodes and electrolytic capacitors are orientated correctly before you solder them in.

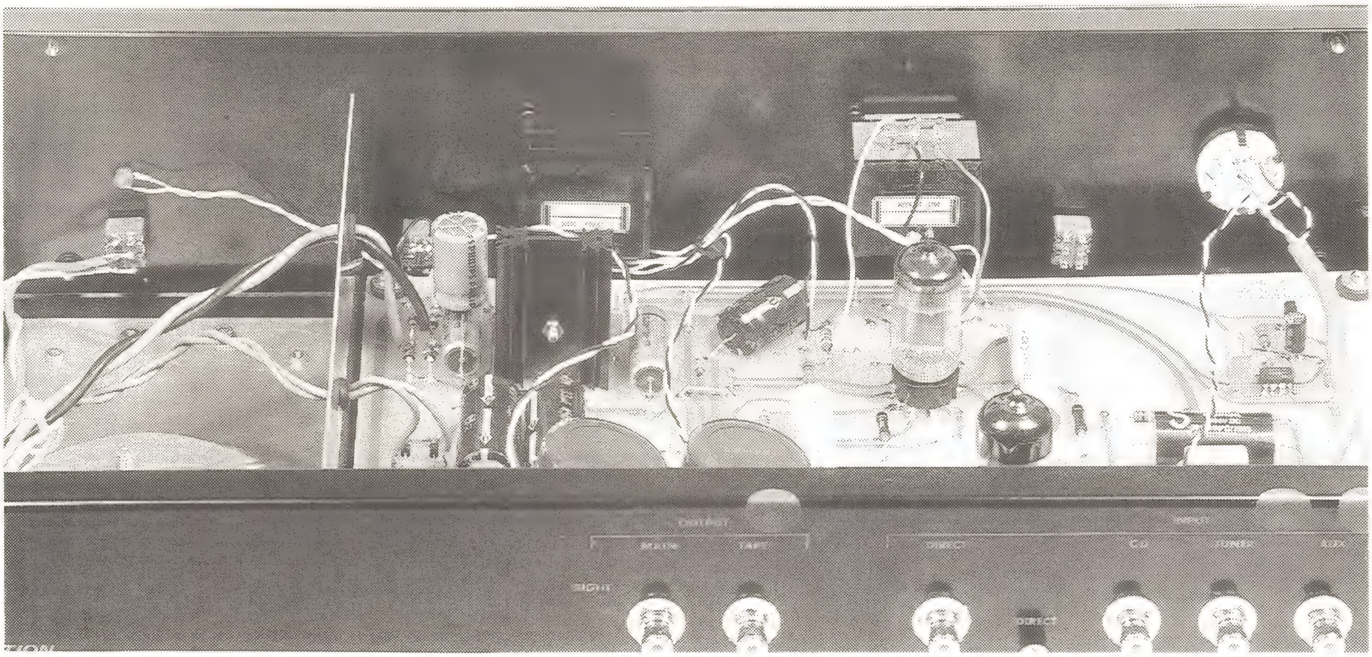
D. Bend the component leads to the required shape (to reach the appropriate PCB pads) carefully using long nose pliers, so as not to strain the component. Do not bend them using your fingers.

E. When soldering a wire to a binding post, ensure that you apply solder to 'tin' both first. This will ensure a good joint.

F. Use only good quality resin core solder, to ensure a solid joint. Ersin 60/40 resin core is suitable, although the author prefers Wonder solder because this has low melting point. A good solder joint should be smooth and shiny.

Do not move the component or wire while the solder is cooling, or you may get a 'dry' joint.

G. Prior to switching on the power, check over the entire amplifier and make sure that all wires and components are in their places and all of the connections are soldered. 99% of the problems that occur with any project are because of unsoldered joints and improperly placed wires.



**Another view inside the case, looking towards the front panel controls. Again, when this photo was taken, the unit concerned did not have the wiring to the normal/direct switch fitted — or all of the wiring to the input selector switch.**

# Valve Preamp for Audiophiles - 2

## Mechanical assembly

The first step in building the preamp is the mechanical assembly. First install the IEC power input connector and the RCA sockets (seven pairs total) in their right locations on the rear panel. Make sure that the mounting nuts on the RCA sockets are well tightened, so that they won't become loose, and also that the ground tags are readily accessible.

Note that all of the ground tags will be connected together, except those for the 'main' preamp outputs.

Now install the selector switch, balance pot and volume pot on the front panel, ensuring that the pot tags are facing upwards to allow easy access for soldering. Also install the toggle switches for defeat/record, mute/operate, direct/normal and power on/off.

The toroidal power transformer can now be mounted as shown in the wiring diagram and internal photo. The mounting bolt is introduced from under the chassis, and has the large neoprene rubber washer fitted first, followed by the transformer itself and then the small neoprene washer and the dished metal washer, and finally a solder lug, lock washer and nut. Don't over-tighten the nut as yet; for those of you who have access to an oscilloscope, it is possible to minimise flux interference with the preamp circuitry (i.e., minimise hum) by rotating the transformer later. This will be explained in the testing section.

## PCB assembly

Follow the PCB wiring diagram closely when soldering the components onto the board. The PCB is single sided, with '2oz' copper (twice the normal weight), and as you can see from the photo it's mounted in the chassis with the copper track side — which is also the component side, in this case — uppermost. Note that some pads on the board are left blank for future use or experimentation.

The PCB assembly procedure is as follows. First, mount all of the low profile components, such as the resistors, diodes, 555 timer chip, transistors and capacitors. Solder all of them in, making sure your joints are firm as they hold the components in position as well as make the connections.

Now solder in the jumper links, as indicated on the PCB layout. Use offcuts from the resistor leads, or short lengths of tinned copper wire. The links can either be fitted under the board, or on the copper side if you wish — but in this case, make sure you loop them away from the board so they don't touch any of the other tracks.

Then mount the heatsink for the LM350 regulator IC, and solder in both this regulator, the TL783 and the IRF830 power MOSFET. At this stage you can also fit the valves sockets and the relay, which is mounted from the underside of the board.

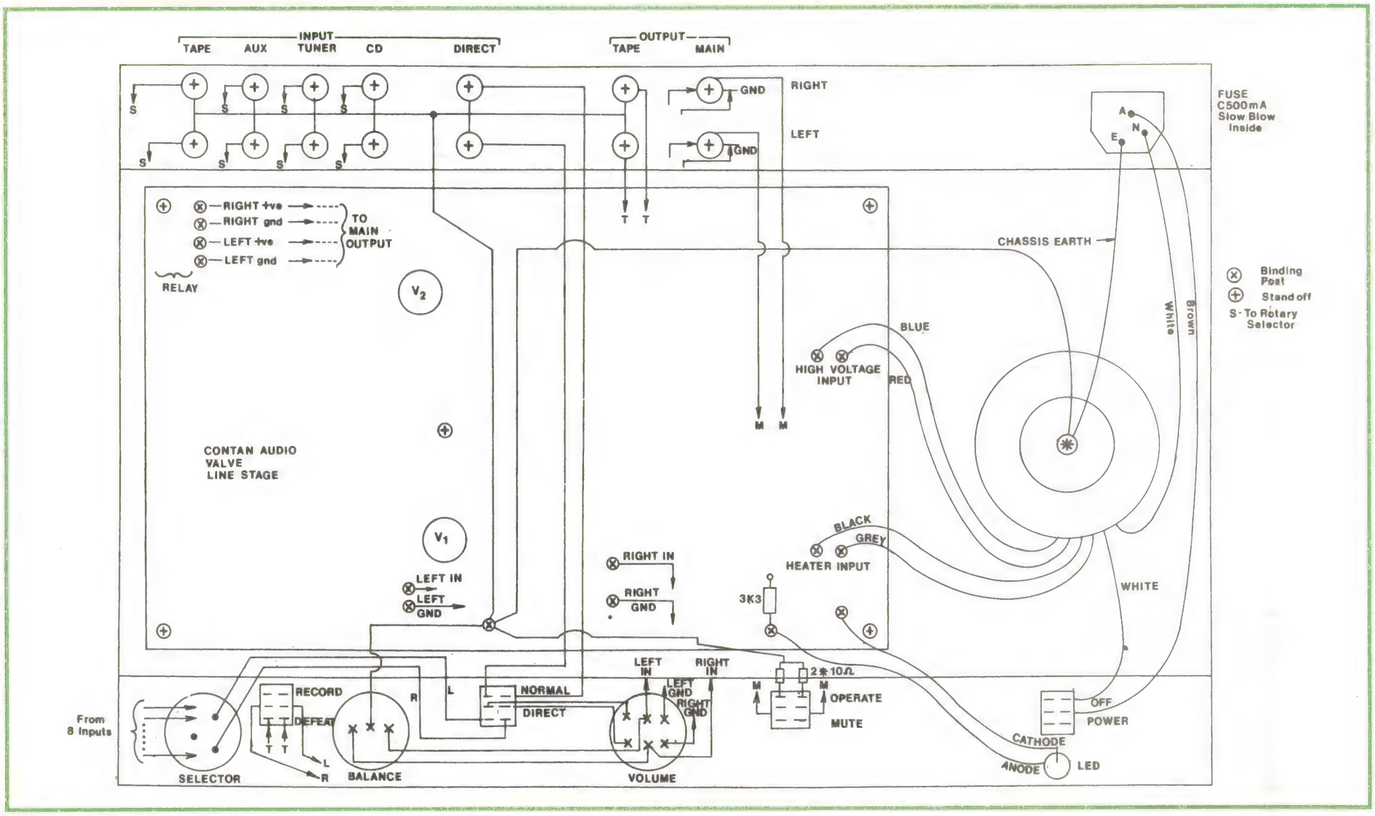
The final step in PCB assembly is fitting and soldering the PCB terminal pins, to take the interconnection wires.

Once you have completed soldering, just make a final check that all of the components are in the correct position. Now is the time to solder in any left over components, rather than later!

At this stage you can mount the completed PCB assembly in the chassis, using the mounting hardware provided. You should then be ready for the 'hard wiring' — that is, the wiring that interconnects the major components, made using conventional insulated wires rather than PCB tracks.

## Hard wiring

Actually the kit is supplied with silver-plated copper wires, and these should be used for all of the signal path interwiring — particularly the inputs and outputs to/from the PCB. Use the wiring diagram



*Use this wiring diagram as a guide when you are making all the interconnections between the preamp PCB and the other main components. Note the central earth point at the front centre of the PCB.*

*A rear view of the preamp. This prototype unit had the direct/normal switch mounted on the rear panel; it is now fitted to the front panel.*

as a guide for this and the rest of the hard wiring.

The first step is to connect all of the ground lugs on the RCA sockets (apart from the two 'Main' outputs) together, using a long copper wire, and then run a wire between this input socket earth line and the main PCB signal earth pin (front centre of the PCB). Another short wire connects the centre lug of the balance pot to this PCB signal earth pin, as well.

Then connect the signal lugs of the 'Direct' RCA inputs to the direct/normal switch as shown, and also connect the other terminals on the switch to the volume control pot and the input selector switch.

Now connect the centre lugs (L&R) of the volume pot to the Left and Right inputs on the PCB, and also to the outer lugs of the balance pot. The preamp outputs from the PCB (near the relay) should also be connected to the 'Main' RCA output sockets.

You can now solder the AC leads from the heater winding on the power transformer (grey and black wires) to the 'heater input' pins on the PCB, bringing them first through the grommetted feedthrough hole in the shield plate, nearest the front panel. Similarly the leads from the transformer's HT secondary winding (blue and red) can be brought through the other grommetted hole, and soldered to the 'high voltage' input pins on the PCB.

Probably it's best to do the transformer primary/AC wiring at this stage. Solder one of the transformer's white wires to the 'neutral' (N) lug of the IEC mains connector, and the other white wire to one lug of the the power switch. The other lug of the power switch is then connected to the 'active' (A) lug of the IEC connector, using a length of mains-insulated wire (preferably colour coded brown or red).

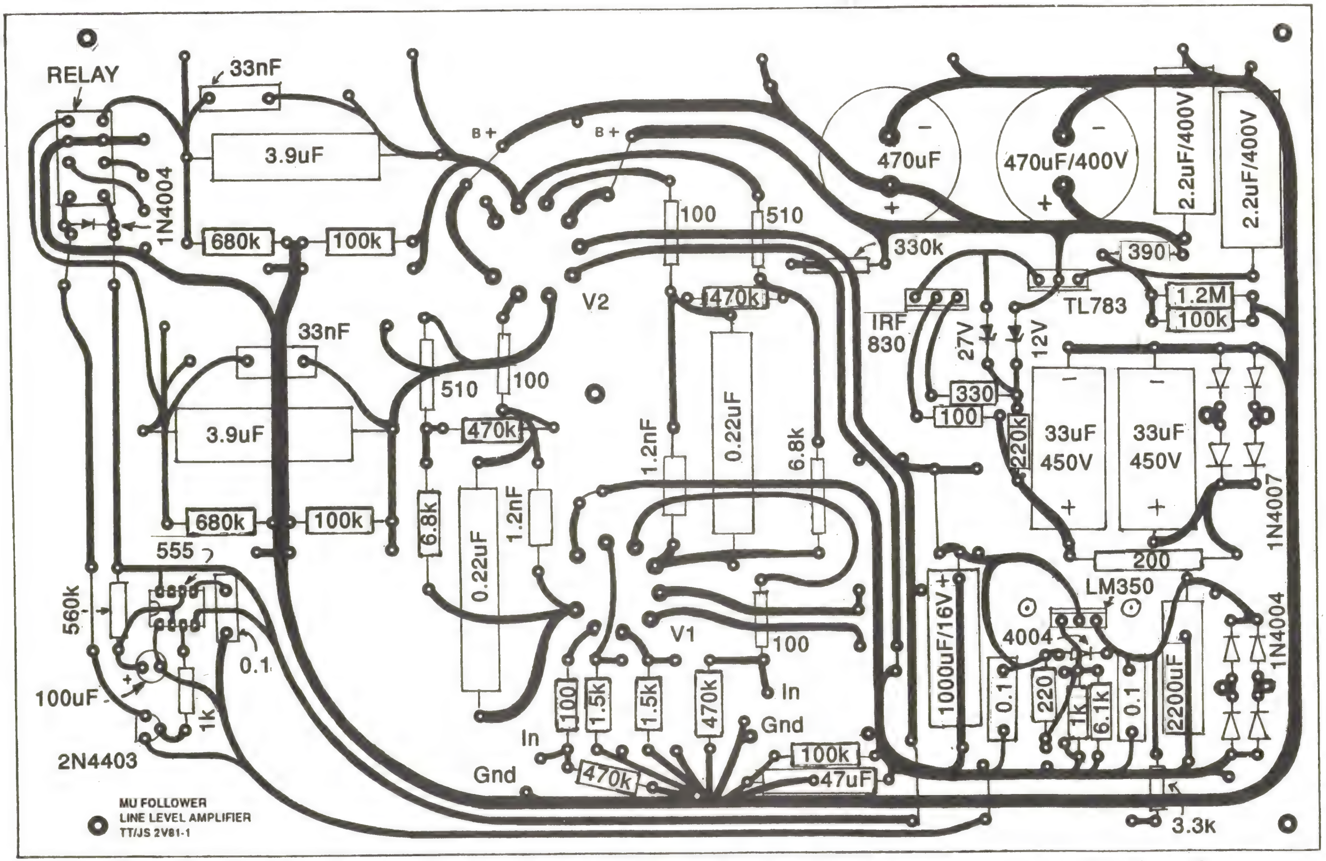
Now run a wire (coded green or yellow/green) from the IEC connector's earth (E) lug to the solder lug mounted under the transformer mounting nut, as described earlier. Also run a similar wire from the same transformer earthing lug to the main earth pin on the PCB (near its front centre), taking the wire through the rear feed-through hole. At this stage you can jump forward to the next section, for testing the PCB, before you complete the rest of the PCB interconnections.

When this has been done, you can complete the assembly by adding the wiring to the LED, the rest of the toggle switches, between all of the RCA input socket signal lugs and the selector switch, and the tape output sockets. Then you should be ready for a final check of all the connections, before fitting the lid.

## Testing time

Now is the time to test whether the preamplifier is working properly. As discussed earlier, the safe method to perform any measurements is to have the common terminal of the multimeter connected to the chassis ground, via an alligator jumper lead.

First, plug in the two valves, the 12AU7/5814 (V1) and the ECC88/6922 (V2). Before connecting the power cord



*As usual, this PCB overlay diagram can be used as a guide when you're fitting the components to the board.*

to the IEC connector, check that the power switch is off. Then turn on the power, and with the help of the circuit diagram and the PCB layout check the following voltages:

1. The B+ should be about +311V (+/-5V). It is regulated, so it should be stable and with no ripple. Reducing the 1.2M resistor connected to the 'Adj' pin of the TL783 regulator will reduce the B+ to about 300V, if you wish.
2. The common side of the heater wiring should be at about +72V above earth (measure at pin1 of the 555 timer chip). The heater line is designed to 'float' at this voltage so that the heater to cathode voltage rating of the top valve (V2) is not exceeded.
3. The voltage on the other side of the heater line should be 6.1V higher than the common voltage (measure at pins 4 or 8 of the 555). The heater supply is purposely designed to be around 6.1V, rather than the traditional 6.3V. (Many audiophiles believe that 6.03V is the ideal heater voltage!)
4. Now check the cathode voltages (pins 3,8) of V1 measure between about +5.3V and +5.4V. The anodes (pins 1,6) should measure around +164V.
5. The circuit should be working properly. Check the timer is working — there should be a 'click' from the relay about one minute after power is applied, as the timer energises it to connect the outputs.
6. With the multimeter on the AC volts setting, the output after the relay should read negligible AC volts — less than 0.003V.
7. If an oscilloscope is available, observe the Main L and R outputs. Only a tiny amount of valve noise should be visible, and possibly some mains hum from the toroidal transformer. The latter can be reduced by rotating the transformer.
8. Now that you are confident that the circuit is working properly, you can return to complete the hardwiring. Or if you're impatient, you may wish to carry out an initial listening test first, as described below.

## Listening tests

Now that you have finished the construction and testing of your amplifier, it is time to reap the reward and listen to it.

By the way, the output of the preamplifier is phase inverted, i.e., 180° shifted in phase compared with the inputs. Because of this, those of you who are purists may wish to reverse the connections to your speakers (both channels), to obtain correct absolute phasing...

There should be no hum at the output of the preamp, and the noise level should be very low as measured by *Electronics Australia* and shown in the box on page 63 of the October 1993 article.

The circuit is flexible enough to allow experimentation, in order to obtain the kind of 'sound' you wish for your system. As described, it should give a smooth 'open' sound without being aggressive. Those of you who want a slightly more 'forward and faster' sound can try changing the 'top' valve V2 to a 12AT7/ECC81.

If you do this, you'll have to change some resistors to get the biasing right for the new valve. Constructors who need further information can contact me for the correct values.

## Obtaining a kit

As mentioned in the first of these articles, a kit for this preamp can be obtained directly from Contan Audio, of 37 Wadham Parade, Mount Waverley, Victoria 3149; phone or fax (03) 807 1263. Here are the options available:

| | |
|---|---|
| PV1: PCB only | $45.00 |
| PV2: PCB and components | $289.00 |
| PV3: Toriodal transformer | $85.00 |
| PV4: Alps volume, balance pots | $49.00 |
| PV5: Complete Preamplifier Kit | $649.00 |
| PV6: Preamp fully assembled, tested and guaranteed* | $849.00 |
| PV7: EA Preamp articles, parts 1&2 | $10.00 |

Enhanced components can be added, please call for prices as there are many options. (* Parts and labour are guaranteed for two years.)

Note that some parts used in the preamp may be subject to change; if alternatives must be used, constructors will be notified. ❖

## PARTS LIST (Basic design)

### *Resistors*

(All 0.25W 1% metal film unless stated)

| | |
|---|---|
| 2 | 10 ohms 0.6W |
| 5 | 100 ohms 1W |
| 1 | 200 ohms 1W |
| 1 | 220 ohms |
| 1 | 330 ohms |
| 1 | 390 ohms |
| 4 | 470 ohms |
| 4 | 1k |
| 1 | 3.3k |
| 1 | 6.1k |
| 2 | 6.8k |
| 4 | 100k |
| 1 | 220k |
| 1 | 330k |
| 4 | 470k |
| 1 | 560k |
| 2 | 680k |
| 1 | 1.2M |
| 1 | Dual 50k volume pot, Alps audio taper |
| 1 | Cemet balance pot |

### *Capacitors*

(All polypropylene unless specified)

| | |
|---|---|
| 2 | 1.2nF |
| 1 | 10nF |
| 2 | 33nF |
| 2 | 0.1uF |
| 2 | 0.22uF |
| 2 | 2.2uF 600VW electrolytic |
| 2 | 3.9uF |
| 1 | 47uF 160VW electro (replaces 10uF) |
| 2 | 33uF 450VW electrolytic |
| 1 | 100uF 16VW electrolytic |
| 2 | 470uF 400VW electrolytic |
| 1 | 1000uF 16VW electrolytic |
| 1 | 2200uF 16VW electro (replaces 2 x 1000uF) |

### *Semiconductors*

| | |
|---|---|
| 6 | 1N4004 rectifier diode |
| 4 | 1N4007 rectifier diode |
| 1 | 1N4742 12V zener diode |
| 1 | 1N4750 27V zener diode |
| 1 | 2N4403 PNP transistor |
| 1 | IRF830 power MOSFET |
| 1 | TL783 adjustable regulator |
| 1 | LM350 adjustable regulator |
| 1 | 555 timer IC |

### *Valves*

| | |
|---|---|
| 1 | 12AU7 or 5814 (V1) |
| 1 | ECC88 or 6922 (V2) |

### *Miscellaneous*

Toroidal power transformer, 270V and 9V secondaries, with mounting hardware; 6V relay, Omron; TO-220 heatsink for LM350 regulator, PCB mounting; LED (red or green) with panel- mounting holder; 2 x valve sockets, polycarbonate; 4 x toggle switches; 2-pole 4-position rotary switch; 14 x RCA sockets, gold plated contacts; 3 x control knoibs, screw type; case and front panel; IEC mains connector, panel mounting with inbuilt fuse; PCB mounting hardware; rubber grommets; hookup wire, silver-plated; solder lugs, solder etc.

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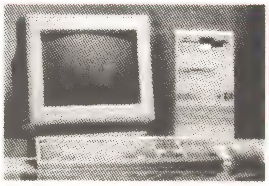

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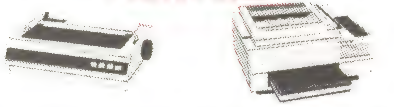

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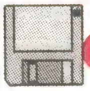

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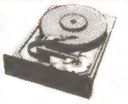

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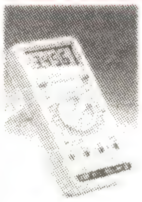

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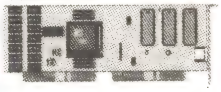

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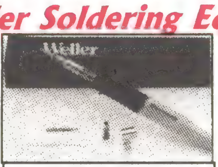

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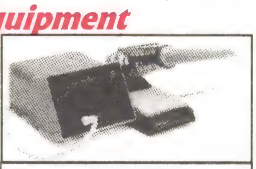

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READER INFO NO. 13

# Experimenting with Electronics

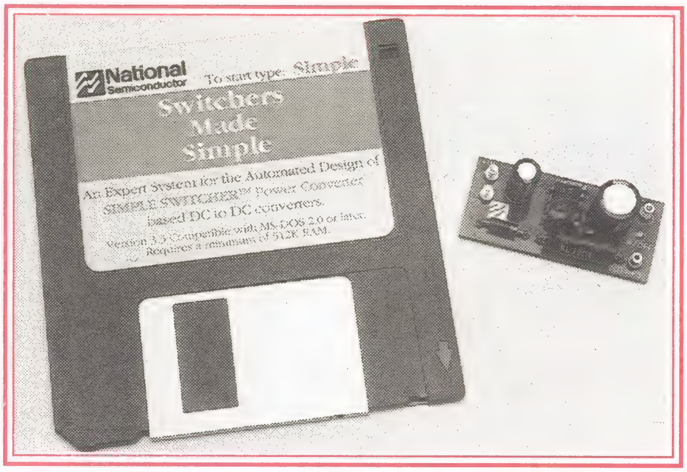
by PETER PHILLIPS

## Switching Regulators

This month we're venturing into an area you might think rather daunting: designing switch mode power supplies. But as you'll see, given the right tools it's now quite simple. Don't believe us? Well, read on...

Our topic this month is by request. Quite a few readers have recently written asking us to describe the design, repair and construction of switch mode power supplies. And to be honest, we haven't been too anxious to respond, as this is one of the more complex areas of electronics. Where do you start — and more significantly, where do you stop?

However, it can be put off no longer. Switch mode power supplies are almost the standard these days, and even the ubiquitous three-terminal linear voltage regulator is now under threat. If this seems improbable, consider this...


National Semiconductor
To start type: Simple
Switchers Made Simple
An Expert System for the Automated Design of SIMPLE SWITCHER™ Power Converter based DC to DC converters.
Version 3.3 Compatible with MS-DOS 2.0 or later.
Requires a minimum of 512K RAM.

***The PCB shown here is a 5V 0.5A switching regulator based on a National Semiconductor switching IC type LM2574. The software lets you design your own switching regulators.***

### Why a switcher?

Nowadays the buzz word is environment. From an electrical standpoint this means the search is on to increase the efficiency of everything that uses electricity. Hence the introduction of energy efficient lights, 3V ICs as alternatives to their 5V counterparts, and so on.

In practical terms, increasing the efficiency of electrical and electronic appliances means fewer nasties get pumped into the atmosphere from power stations. And because nearly everything electronic has a power supply, it was only a matter of time before design engineers explored this area.

Over the last 10 or 15 years, we have seen switch mode power supplies of ever decreasing size, appear in an ever increasing range of equipment. While usually quite reliable, like any power supply, they are prone to breakdown. Hence the letters from our readers seeking information on how to fix these complex items.

But an area of even more interest is the push by industry to replace three-terminal linear voltage regulators with a switching equivalent — something you might find rather hard to believe. Surely (you'd think) there is nothing simpler or more reliable than a three-terminal voltage regulator IC. Apply a crude DC source to its inputs, and out comes a tightly regulated voltage with virtually no ripple. As well, there's inbuilt current and temperature limiting.

But think about the energy being wasted by these devices. For example, a typical 5V 1A supply needs an input DC source of at least 8V, usually 10V to allow a margin of change at the input. If the regulator is delivering 1A to the circuit, the power taken by the circuit is, at best, 10 x 1 = 10W. The power consumed by the circuit connected to the regulator is 5V x 1A = 5W. So half the input power is being dissipated as wasted heat. Now multiply this loss by the world-wide number of three-terminal regulators in use at a particular time and you can see it starts to add up.

To meet this challenge, semiconductor manufacturers have been channeling considerable efforts into designing switching regulator ICs with similar specifications to linear regulators. And of particular interest is how they are making these ICs acceptable, to the likes of you and I.

Standing out in their efforts to have us change our ways is National Semiconductor (NS), which has produced a range of 'switcher ICs' and some very effective computer software that lets you design your own power supply.

The IBM compatible software is being distributed free, although you might have to pay the cost of a disk. The software supports a range of switcher ICs developed by NS, which include step-up as well as

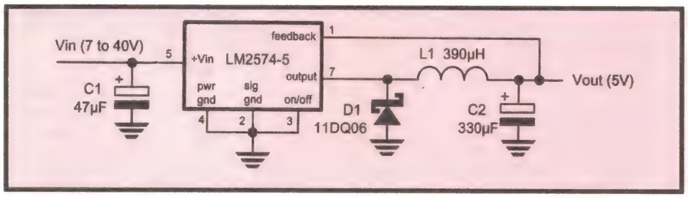


***Fig.1: This is the circuit of the PCB supplied in the evaluation kit for their range of switching regulators.***

**Table 1: NS step-down (buck) converters**

| Load current | Output voltage | | | | |
|---|---|---|---|---|---|
| | 3.3V | 5V | 12V | 15V | adjustable (1.23V to 57V) |
| 0.5A | LM2574-3.3<br>LM2574HV-3.3 | LM2574-5<br>LM2574HV-5 | LM2574-12<br>LM2574HV-12 | LM2574-15<br>LM2574HV-15 | LM2574-ADJ<br>LM2574HV-ADJ |
| 1A | LM2575-3.3<br>LM2575HV-3.3 | LM2575-5<br>LM2575HV-5 | LM2575-12<br>LM2575HV-12 | LM2575-12<br>LM2575HV-15 | LM2575-ADJ<br>LM2575HV-ADJ |
| 3A | LM2576-3.3<br>LM2576HV-3.3 | LM2576-5<br>LM2576HV-5 | LM2576-12<br>LM2576HV-12 | LM2576-15<br>LM2576HV-15 | LM2576-ADJ<br>LM2576HV-ADJ |

Note: Vin max is 40V, for HV version Vin max is 60V. Vin min is 2V higher than Vout.

**Table 2: NS step-up (boost) converters**

| Device no | Vin | Vout | $I_{load}$ | $I_{switch}$ |
|---|---|---|---|---|
| LM2577-12 | 3.5V to 10V | +12V | 0.6A | 3$A_{max}$ |
| LM2577-15 | 3.5V to 12V | +15V | 0.5A | |
| LM2577-ADJ | 3.5V to 40V | 5V to 60V | varies | |

**Table 3: NS flyback (±) converters**

| Device no | Vin | Vout | $I_{load}$ | $I_{switch}$ |
|---|---|---|---|---|
| LM2577-12 | 5V<br>10 to 12V<br>15V | ±12V | ±275mA<br>±600mA<br>±825mA | 3$A_{max}$ |
| LM2577-15 | 5V<br>10 to 12V<br>15V | ±15V | ±225mA<br>±575mA<br>±700mA | |
| LM2577-ADJ | 3.5 to 40V | ± adjustable | varies | |

step-down devices, with current ratings from 0.5A to 3A. So we're going to look at these devices and what the software will do for you. On the way, I hope you'll get a feel for switch mode supplies, and perhaps get the courage to tackle the topic in a more in-depth way via texts on the subject.

## Overview

NS call their switching regulators the Simple Switcher family. The software, predictably, is called *Switchers Made Simple*. There are four basic part types in the Simple Switcher family. Three devices, the LM2574, '75 and '76 are step-down (or 'buck') regulators rated at 500mA, 1A and 3A respectively, with fixed output voltages of 3.3, 5, 12 and 15V. There's also an adjustable-output version for each type. These devices are listed in Table 1.

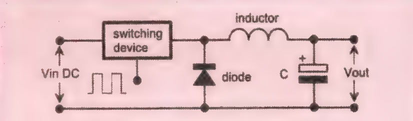
The fourth device, in Tables 2 and 3 is the LM2577, a 3A rated step-up, or 'boost' regulator which converts an input voltage to a *higher* regulated output voltage. It's available in either fixed output (12 or 15V) versions, or as an adjustable regulator with an output range up to 64V. The standard version of each device has a maximum input voltage of 40V. The HV version of each device can accept an input up to 60V. The minimum input voltage for the step-down devices is 2V above the output voltage.

The *Switchers Made Simple* software has been developed by National over a period of some years, and I'm describing version 3.3. More on the software as we go.

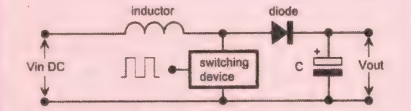
## Performance

The evaluation kit we received from National contained a ready-built 5V regulator using the LM2574-5 device. The PCB is shown in the photo, and measures 45 x 20mm. As you can see the IC is an eight-pin DIL device, there's no heatsink and there are only four support components for the IC: two capacitors, an inductor and a Schottky diode. Its circuit is shown in Fig.1. Naturally I had to see for myself what the device could do, and I have to admit to being impressed. The test I conducted was simple enough: connect a 10 ohm resistor to the output of the switching regulator and measure the input current for a range of input voltages.

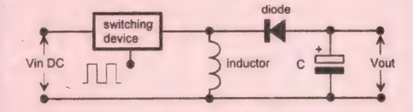
Then I repeated this for a linear regulator. Finally, from the results, I calculated the efficiency for each value of the input voltage.



(a) Step-down or buck regulator



(b) Step-up or boost regulator



(c) Inverting regulator

***Fig.2: Shown here are the three basic switching regulator topologies.***

The results are given in Tables 4 and 5. The quiescent, or no-load current is about the same for both regulator types. The output voltage regulation of the switcher is not as tight as the linear regulator, but still respectable. But look at the efficiency figures!

The best figure for the linear regulator is for a 7V input, which is the absolute minimum for a 5V device to still give the required 2V drop across the regulator. This efficiency is comparable to that of the switching regulator for the same input voltage, but at the cost of a dangerously low overhead voltage across the regulator.

Once the input voltage rises, things look remarkably better for the switcher, with nearly 77% efficiency at 20V input compared to a miserable 24.3% for the linear device.

During the test, the switching regulator hardly got warm, while the linear regulator got too hot, and I had to interrupt the test. For the LM2574-5, National claim an efficiency of 77% with an input voltage of 12V and a load current of 0.5A. For the 12V and 15V regulators, the claimed efficiency is up to 88%.

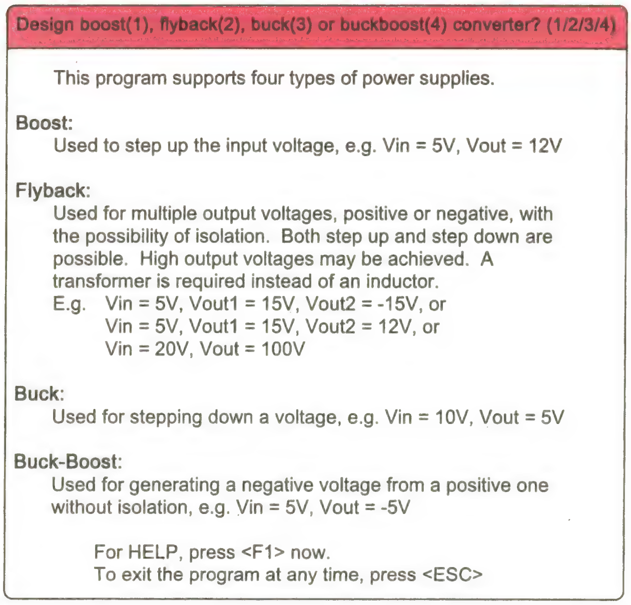
A fact of life with any switching regulator is radio frequency interference (RFI), also called electromagnetic interference (EMI). The test PCB as supplied gave about 15mV of 50kHz ripple at the output, which rose to 37mV when the circuit was fully loaded.

In sensitive applications, additional LC filtering might be needed, but otherwise this level of ripple is not usually a problem.

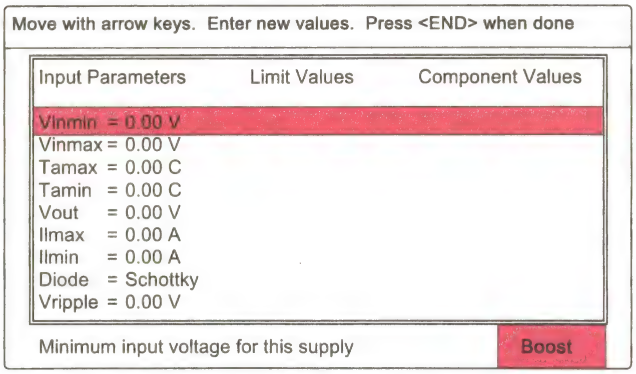
Now that you know something about the 'simple switchers', we're ready to develop some circuits.

## Regulator topologies

There are three basic switching regulator topologies: step-down or 'buck', step-up or 'boost', and inverting or 'buck-boost'. The circuit in Fig.1 is a step-down regulator, and a simplified version is also shown in Fig.2(a). The output voltage is always less than the input voltage and a semi-

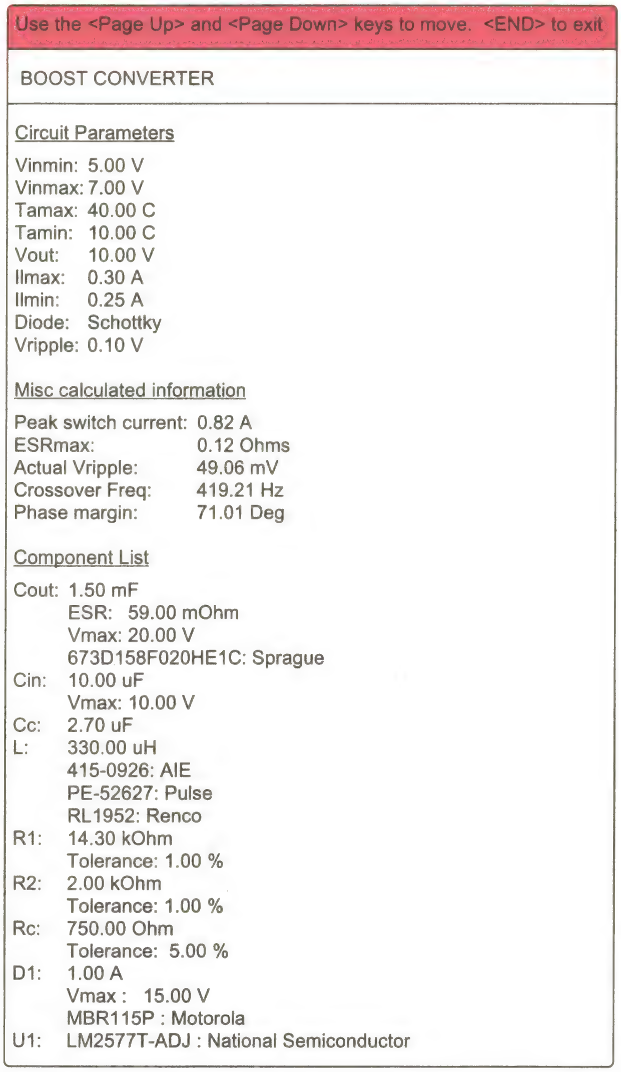


```
Design boost(1), flyback(2), buck(3) or buckboost(4) converter? (1/2/3/4)

    This program supports four types of power supplies.

Boost:
    Used to step up the input voltage, e.g. Vin = 5V, Vout = 12V

Flyback:
    Used for multiple output voltages, positive or negative, with
    the possibility of isolation.  Both step up and step down are
    possible.  High output voltages may be achieved.  A
    transformer is required instead of an inductor.
    E.g.   Vin = 5V, Vout1 = 15V, Vout2 = -15V, or
           Vin = 5V, Vout1 = 15V, Vout2 = 12V, or
           Vin = 20V, Vout = 100V

Buck:
    Used for stepping down a voltage, e.g. Vin = 10V, Vout = 5V

Buck-Boost:
    Used for generating a negative voltage from a positive one
    without isolation, e.g. Vin = 5V, Vout = -5V

        For HELP, press <F1> now.
        To exit the program at any time, press <ESC>
```



```
Move with arrow keys.  Enter new values.  Press <END> when done

 Input Parameters        Limit Values        Component Values

 Vinmin  = 0.00 V
 Vinmax  = 0.00 V
 Tamax   = 0.00 C
 Tamin   = 0.00 C
 Vout    = 0.00 V
 Ilmax   = 0.00 A
 Ilmin   = 0.00 A
 Diode   = Schottky
 Vripple = 0.00 V

 Minimum input voltage for this supply
```

***Fig.3 (top): This is the main menu screen of the Switchers Made Simple software, developed by National Semiconductor to support their switching ICs. Fig.4 (below): At this screen, you enter the values you want for the design.***



```
Use the <Page Up> and <Page Down> keys to move.  <END> to exit

BOOST CONVERTER

Circuit Parameters
Vinmin:  5.00 V
Vinmax:  7.00 V
Tamax:   40.00 C
Tamin:   10.00 C
Vout:    10.00 V
Ilmax:   0.30 A
Ilmin:   0.25 A
Diode:   Schottky
Vripple: 0.10 V

Misc calculated information
Peak switch current:  0.82 A
ESRmax:               0.12 Ohms
Actual Vripple:       49.06 mV
Crossover Freq:       419.21 Hz
Phase margin:         71.01 Deg

Component List
Cout:  1.50 mF
       ESR:   59.00 mOhm
       Vmax: 20.00 V
       673D158F020HE1C: Sprague
Cin:   10.00 uF
       Vmax: 10.00 V
Cc:    2.70 uF
L:     330.00 uH
       415-0926: AIE
       PE-52627: Pulse
       RL1952: Renco
R1:    14.30 kOhm
       Tolerance: 1.00 %
R2:    2.00 kOhm
       Tolerance: 1.00 %
Rc:    750.00 Ohm
       Tolerance:  5.00 %
D1:    1.00 A
       Vmax :   15.00 V
       MBR115P : Motorola
U1:    LM2577T-ADJ : National Semiconductor
```

***Fig.5: Here's the parts list and circuit parameters of the boost circuit shown in Fig.6, as printed by the software.***

conductor switch is in series with the input DC supply.

The switch interrupts the DC input, providing a variable-width pulse to a simple averaging LC filter. When the switch is closed, the DC input voltage is applied across the filter and current flows through the inductor to the load. When the switch is opened, the energy stored in the field of the inductor maintains current flow into the load, via the diode.

The boost regulator is shown in simplified form in Fig.2(b). In this circuit, the output voltage is always greater than the input voltage. The boost circuit first stores energy in the inductor and then delivers this stored energy along with energy from the DC input voltage to the load.

When the switch is closed, current flows through the inductor and the switch, charging the inductor, but delivering no current to the load. When the switch is opened, the voltage across the load equals the DC input voltage plus the charge stored in the inductor. The inductor discharges, delivering current to the load.

The inverting regulator, shown in Fig.2(c) is a variation of the boost circuit. This type of regulator only delivers energy stored in the inductor to the load, and can step the input voltage up or down.

When the switch is closed, the induc-

**Table 4: Efficiency, 5V switching regulator LM2574**

| Vin DC (volts) | $\text{Iin}_{\text{no load}}$ (mA) | $\text{Vout}_{\text{no load}}$ (volts) | $\text{Iin}_{\text{load}}$ (ma) | $\text{Vout}_{\text{load}}$ (volts) | $\text{Pin}_{\text{load}}$ (watts) | $\text{Pout}_{\text{load}}$ watts | efficiency % |
|---|---|---|---|---|---|---|---|
| 7 | 7.3 | 5.06 | 500 | 5 | 3.5 | 2.5 | **71.43** |
| 10 | 6.2 | 5.08 | 340 | 5.01 | 3.4 | 2.51 | **73.82** |
| 15 | 5.7 | 5.08 | 222 | 5.03 | 3.33 | 2.53 | **75.98** |
| 20 | 5.5 | 5.09 | 166 | 5.04 | 3.32 | 2.54 | **76.51** |

**Table 5: Efficiency, 5V linear regulator 7805**

| Vin DC (volts) | $\text{Iin}_{\text{no load}}$ (mA) | $\text{Vout}_{\text{no load}}$ (volts) | $\text{Iin}_{\text{load}}$ (ma) | $\text{Vout}_{\text{load}}$ (volts) | $\text{Pin}_{\text{load}}$ (watts) | $\text{Pout}_{\text{load}}$ watts | efficiency % |
|---|---|---|---|---|---|---|---|
| 7 | 5.5 | 5.07 | 529 | 5.07 | 3.7 | 2.57 | **69.42** |
| 10 | 5.6 | 5.07 | 529 | 5.07 | 5.29 | 2.57 | **48.59** |
| 15 | 5.8 | 5.07 | 529 | 5.07 | 7.94 | 2.57 | **32.39** |
| 20 | 5.9 | 5.07 | 529 | 5.07 | 10.58 | 2.57 | **24.3** |

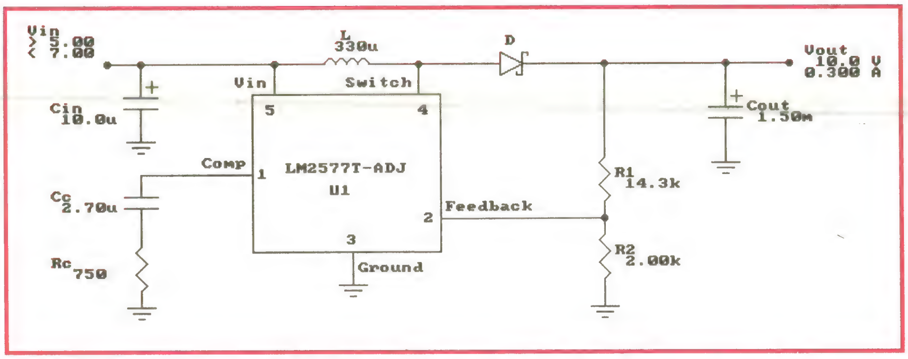


*Fig.6: The circuit of a boost regulator as printed by the NS software. The output is regulated by the feedback from R1 and R2. Cout is a 1500uF electrolytic capacitor.*

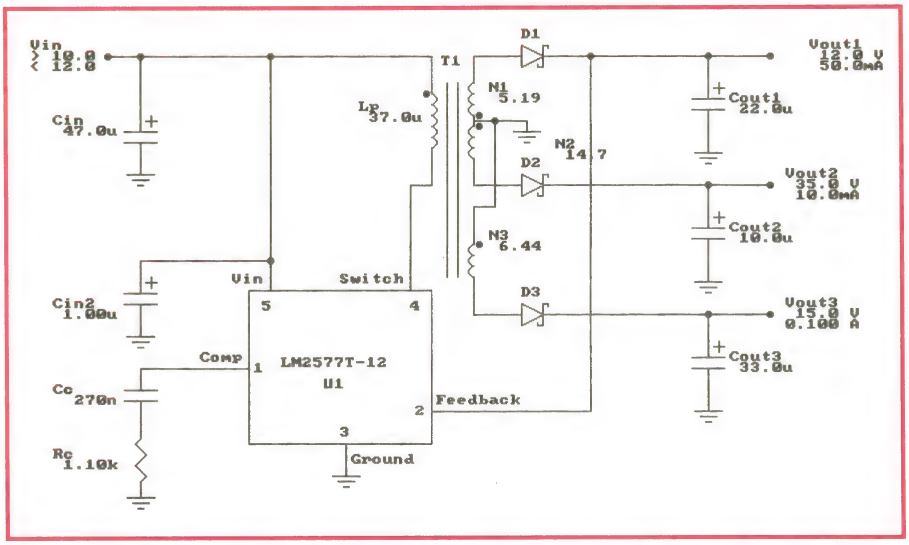


*Fig.7: This is a three output flyback switching regulator, again printed directly from the program. The regulator is a TO-220 package, and no heatsink is needed.*

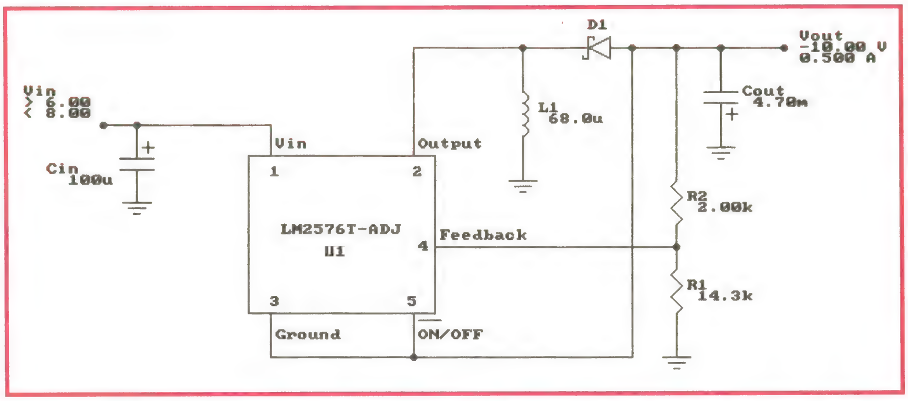


*Fig.8: The buckboost configuration can produce a negative voltage from a positive supply. This circuit gives a -10V out at 0.5A from an input between 6 and 8V.*

tor is charged (magnetic field increases), but no current is delivered to the load because the diode is reverse biased. When the switch is opened, the magnetic field collapses and the diode is forward biased, allowing the energy stored in the load to be transferred to the load.

A variation of the inverting regulator is the 'flyback' configuration, which uses a transformer to give a number of outputs, either higher or lower than the input.

## The software

The *Switchers Made Simple* software, despite its arcane text-based interface, is sophisticated and quite easy to use. An example will illustrate, so let's design a circuit using the program.

When you first enter the program, after two title screens, you get to the display shown in Fig.3. Here you get a short overview of the four regulator designs supported by the program. If you've already designed a circuit, the top line will ask if you want to re-examine an old design, or start a new one. Responding by pressing N (for new) gets you to the screen as shown in Fig.3.

We'll press <1> for a boost design, and the next screen, shown in Fig.4, invites you to enter the parameters you want for the circuit. When these are entered, pressing the <END> key causes the program to ask if you want to use a standard inductor. Pressing <Y> invokes the next display which asks if you want to change any of the input parameters. Also shown are the component values needed in the circuit.

Following screens invite you to run a thermal check on the circuit, which requires a package style for the regulator IC to be selected. Then the program advises if a heatsink is required and gives the junction temperature.

Once the design is accepted, you can save it to disk for future recall. Then the program asks if you want to see the circuit diagram of the regulator just designed. Pressing <Y> gives a black screen with a white circuit diagram with all the component values. The circuit can be printed out on either an Epson or a HP compatible laser printer, (via parallel port LPT1 only). The parts list can also be printed.

The circuit of the regulator just designed in shown in Fig.6, as printed by the software. The parts list for the circuit is shown in Fig.5. The part numbers for the components are for particular suppliers in the US. And that's all there is to the design process. Of course, there's more to it if you want to get into details. For example, notice the ESR (equivalent series resistance) rating of the capacitor. There's also values in Fig.5 for phase margin and crossover frequency, which are terms you might be familiar with, but not when applied to switch mode power supplies.

The software has a fairly extensive help file, which gives an explanation of these terms and other aspects of designing a switching regulator. In other words, the software is also a useful learning tool.

## Flyback regulator

Many power supplies need a number of output voltages, which is

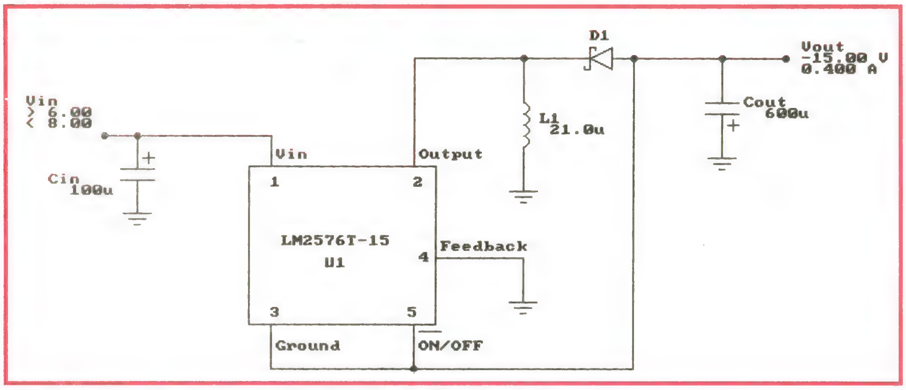


***Fig.9: Another buckboost circuit is shown here. This one uses a fixed-output switching regulator type LM2576T-15, giving an output of -15V.***

where the flyback configuration is used, as the circuit has a transformer. The software supports a circuit with up to three outputs. Fig.7 shows a flyback switching regulator with three outputs: 12V at 50mA, 35V at 10mA and 15V at 0.1A. The input voltage is between 10 and 12V.

The only complex item in the circuit is the transformer. The important characteristics of this device are its primary leakage inductance (37uH) and the turns ratio for each winding. The turns ratios shown on the circuit are relative to a primary winding of one turn. The only extra information about the transformer given in the parts list is a primary current of 2.32A peak.

The help file in the software gives more information about transformer specifications, including making your own. However, the information is relatively brief, and gives no details of minimum primary turns or type of core. Notice that Vout1 is the regulated output, which National refer to as the *prime* output.

## Buck-boost circuit

The buck-boost switching circuit like that shown in Fig.8 can produce a negative output voltage. The circuit shown has an output of -10V at 0.5A, for an input voltage between 6 to 8V.

Changing the feedback resistors (R1 and R2) changes the output voltage. However, for a given load current, the input current will increase as the output voltage is raised. To avoid damaging the IC, the design should be checked at its maximum output voltage.

All the circuits so far have used the ADJ version of the IC family. The buck-boost circuit in Fig.9 uses a fixed output regulator, type LM2576-15. The output is -15V at a maximum current of 0.4A, for an input voltage between 6 to 8V.

## High current

The maximum output current of the Simple Switcher family is 3A. A 5V supply with a rated output current of 3A is shown in Fig.10. However, unlike all the other circuits we've designed, this one needs a heatsink. When a heatsink is needed, the program asks you to select its thermal resistance, giving the maximum allowable value. The program won't design the heatsink, but it will tell you the operating temperature of the junction when you enter a thermal resistance value.

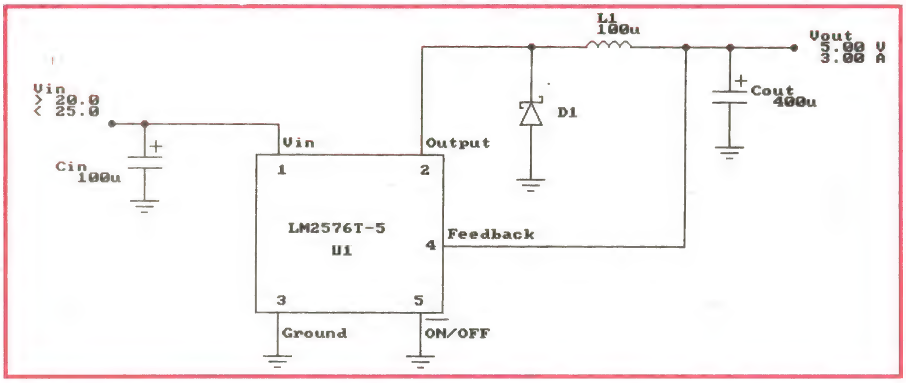


***Fig.10: This regulator needs a heatsink, but can deliver 3A at an output voltage of 5V.***

## Conclusion

There's virtually no limit to the range of switching circuits that can be developed with these ICs. The data sheets for the devices give a range of circuits, including a 1.2V to 55V adjustable 3A power supply. There's also quite a lot of useful information, along with the device characteristics.

Another excellent source of information for these devices is National Semiconductor's *Linear Applications Seminar 1992*, pages 3-29 to 3-52. Here you'll find a lot of information, such as measuring the ESR of a capacitor, reducing EMI and reducing the output ripple voltage.

As well, there's a range of circuits beyond the scope of the *Switchers Made Simple* program, such as a 'Telecom' -48V to 5V 1A converter and a 5V 4A supply. There's also discussion on techniques like connecting switching regulators in parallel, including a reasonably simple circuit for a 15V/9A supply that uses three LM2576-15 switchers connected in parallel.

There's little doubt that switching regulators are going to eventually replace linear regulators. After all, a power supply that doesn't get hot is every designers dream. And as you can now see, a switching regulator circuit might have as few as four extra components.

A suitable inductor and Schottky diode (or fast diode) are the only unusual components. You could try Oatley Electronics for these, as some of their projects use an NS switching regulator. Other suppliers are also likely to stock these components, and as demand increases they will become far more readily available.

But of most importance, NS have solved the main problem: the availability of design software that's effective, cheap and easy to use. Now you have no excuse to stick to linear regulators!

The NS Simple Switcher chips themselves (or at least some of the range) are available from stockists such as Geoff Wood Electronics, of 229 Burns Bay Road, Lane Cove West 2066; phone (02) 428 4111, or fax (02) 428 5198. If you have any trouble getting a copy of the *Switchers Made Simple* software, its available on the Mt Druitt TAFE Bulletin Board system: call (02) 839 1310, and after registering look in the 'Electronic Trades' file area. ❖

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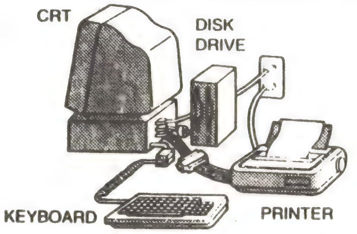

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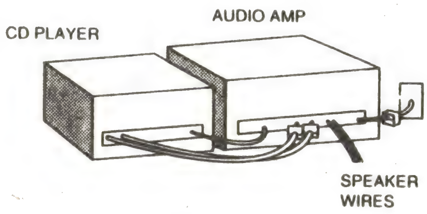

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# DIGITAL PULSE GENERATOR USING AN ALTERA EPLD - 2

Having given an introduction to the operation and use of Altera's family of EPLD (erasible programmable logic devices) in the first of these articles, the author now proceeds to describe his low cost pulse generator project based on the EPM7064 device.

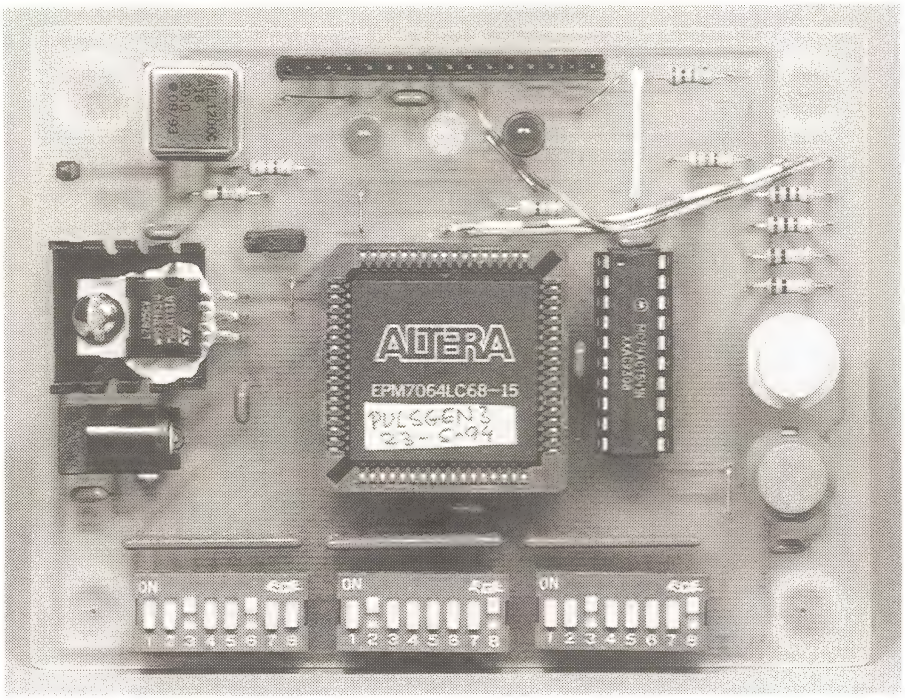
**by DAVID N. WARREN-SMITH**

As the purpose of this project has been to demonstrate the use of Altera's EPLDs, an objective has been to fit as much functionality as possible into the EPM7064 device. For minimum cost, the lowest speed rating version of this device has been used. All internal logic uses fully synchronous circuitry driven by the 20MHz clock.

Another objective has been to make the 7064 device contain all of the logic functions of the project, and make use of a significant proportion of the performance capability of the device. All components have been placed on a single sided printed circuit board which has no enclosing box.

The layout, with the 68-pin PLCC socket for the EPM7064 roughly in the centre, allows everything to be seen for demonstration purposes. This arrangement also eliminates the need for external wiring for controls for setting up the operating conditions, which greatly simplifies the construction.

All operating conditions are set up on three octal DIP switch packs mounted directly on the board. The DIP switches are set with a small pointed stick (a satay stick from the kitchen cupboard works fine).



Outputs from the pulse generator are on a 16-pin header. The header both saves space and provides a convenient means of connecting to a breadboard setup. It also provides for some degree of user configuration. For example a 50-ohm termination is available for use with an external trigger pulse or with an external source of clock signals.

Buffering for inputs and outputs is provided separately through a 74ACT541 octal buffer. The 74ACT541 is capable of driving 50-ohm terminated lines, and can also drive both 5V CMOS and TTL logic circuits. There is one spare buffer, available through the 16-pin header.

Both true and inverse buffered pulse outputs are provided. If a delay is not required prior to the pulse, the inverse output can be used to generate a pulse immediately. The full sequence is required for the continuous mode of operation.

### TABLE 1: DIP switch functions

Note that individual DIP switches represent logic true in the ON position. There are three octal DIP switches. With the unit orientated with the DIP switches at the front and the DC jack on the left, the DIP switch packs are designated: Function DIP, DIPA and DIPB. DIP switch settings representing numbers have the least significant bit on the right according to conventional use. The functions of the DIP switches are as follows:

| Switch | Pin | Function |
|---|---|---|
| Function DIP | 1 | ON One-shot mode, OFF continuous |
| | 2 | ON 5us, OFF 500ns (Start pulse) |
| | 3-5 | FUNCA clock rate for pulse delay |
| | 6-8 | FUNCB clock rate for pulse width |
| DIPA | 1-8 | 8-bit setting for pulse delay |
| DIPB | 1-8 | 8-bit setting for pulse width |

## Output frequencies

The variable rate pulse generator is not the same as a frequency synthesiser. Available output frequencies start at 10MHz and go in initially large steps, determined by f= (20/*n*)MHz, where *n* is an integer between 2 and 512, when the highest internal clock speed is used. A separate buffered 20MHz clock output is provided on the 16-pin header.

It is not essential to use a 20MHz crystal module. The unit will work just as well with any lower frequency oscillator module and will then give a corresponding increase in the length of pulses generated.

The pulse generator will count down the 20MHz reference signal in decades to provide a variable rate source of internal clock signals. Six decade counters

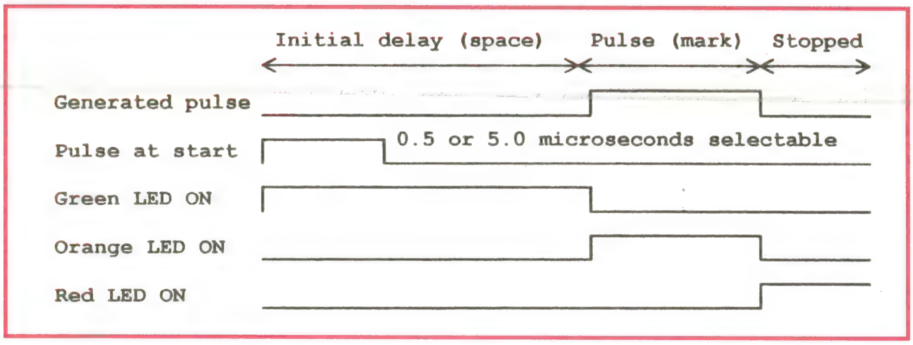


***Fig.4: The sequence of events generated in the one-shot mode of operation.***

and one binary counter are provided. This represents the maximum number of pulse rate counters that could be fitted into the EPM7064 device, after other desired circuitry had been defined. Actually more counter stages could have been included, but only by sacrificing the pin-out desired for the single sided printed circuit board.

An additional octal counter stage counts down alternately in two count limits, determined by two 8-bit DIP switches. These count limits provide the initial delay and the pulse width respectively. The use of an octal counter rather than two decade counters provides the maximum range of counts from these counters, at no great inconvenience in setting the count limits. It is also sometimes useful to be able to progressively double the pulse width.

The pulse generator will operate in either a one-shot mode or a continuous mode. The one-shot mode may be started by either a pushbutton, mounted on the PCB, or an externally applied positive-going trigger pulse. If the manual START push button is used, the manual RESET button has to be pressed before a new manual start can be initiated. A reset is not required if an external trigger pulse is used.

The external trigger pulse is assumed to be a clean signal — as derived from another PULSGEN unit, for example. In the one-shot mode, an additional output will provide a 0.5us or 5.0us pulse at the start of each pulse sequence. This pulse occurs for both the manual and pulse triggered one-shot, but not for the continuous mode of operation.

Fig.4 illustrates the pulses generated by the unit and the use of the three LEDs. For very short pulses, the green and orange LEDs may not show a perceptible indication; however the red LED clearly shows when the pulse has completed. For continuous operation the relative brightness of the green and orange LEDs gives a useful indication, while for long pulses they give a direct indication of the status of the pulse.

The effective clock signal for the variable count limit circuits will come from the decade counter chain as selected by an additional three positions on a function DIP switch, for each count limit. Consequently the pulse generator will deliver a variable rate, variable mark/space ratio pulse over a wide range of pulse rates.

The highest effective internal clock frequency is obtained when the 20MHz signal is used directly. If either the initial delay or the pulse width uses this clock frequency, the resolution will be 50ns. At the lower internal clock frequencies the resolution will be progressively less. This is simply a compromise between getting the maximum range of widths and delays, and getting the maximum resolution. Also the number of octal DIP switches could be minimised.

A distinction should be made for the effective internal clock frequency. Actually, all internal circuitry uses the 20MHz clock directly, to preserve the synchronous operation of the system. The *effective* internal clock is a logic function. This will hopefully become clear when it is described more fully later.

The remaining two positions on the function DIP switch are used for:

1. Selecting either one-shot or continuous mode of operation. One-shot operation is achieved with this switch in the ON position and continuous operation with the switch in the OFF position.
2. Select the width of the synchronous start pulse for the one-shot mode. With this switch in the ON position, a 5.0us pulse will be generated at the commencement of the start of one-shot operation, while in the OFF position a 500ns pulse is generated.

If the unit is driven in one-shot mode from a continuous source of pulses with a period less than the length of the start pulse, then this pulse will not occur continuously. A choice of 50ns or 500ns pulses could have been implemented, but the 50ns pulses could be hard to use.

It may be necessary to press the RESET button after changing modes or changing the DIP switch settings whilst the unit is running, to reinitialise it.

The conceptual circuitry of the variable rate pulse generator can be seen in the two block diagrams of Fig.5. The actual circuitry is defined using the Altera hardware description language (AHDL). Drawing an actual circuit would have

## Specification

1. **FREQUENCY AND PULSE WIDTH RANGES**

   Maximum clock frequency: 20MHz
   20MHz Crystal Oscillator frequency stability: +/-100ppm
   Provision is made for individual settings for the mark and space of the pulses generated as follows:
   Clock frequency selectable in eight steps: seven steps in decades from 20MHz down to 20Hz and the final binary step to 10Hz.
   Pulse width and space between pulses can be set in the range 1:1 - 1:256 for a given clock frequency.
   Periods of pulses and spaces between pulses range from 50ns to 25.6 seconds.

2. **OPERATING MODES**

   Provision for continuous or one-shot operation.
   Manual START and RESET for one-shot operation.
   External trigger input for one-shot operation.
   Additional Start pulse of 500ns or 5us in one-shot mode.
   Green, orange and red LEDs provided for mode display.

3. **INPUTS AND OUTPUTS**

   All inputs and outputs on a 16-pin header strip.
   True and inverted main pulse outputs.
   Outputs capable of driving 5V CMOS or TTL circuits.
   Output drive capability: 24mA source or sink current.
   Capability to drive 50-ohm transmission line.
   Input signal requirements for external trigger or reference frequency: TTL level.
   Configuration options provided on the 16-pin header.

4. **MECHANICAL/ELECTRICAL**

   All circuitry on a single sided, free standing printed circuit board (approx 80 x 105mm).
   Provision for rubber feet.
   External power source of 7.5 - 12V unregulated DC at nominally 140mA for on-board regulator.

# DIGITAL PULSE GENERATOR USING AN ALTERA EPLD - 2

very little relevance, due to the complexity of the logic generated by the software compiler, and would be unnecessarily complicated to describe.

Not shown on the block diagram are the fact that all switch inputs are actually active-low inputs, and LED outputs are also active low. This is taken into account in the AHDL source code.

The main components of the circuitry are the decade counters, the octal counter and the two state machines that control the operation of the system.

Considering the decade counters first, these are down counters which are reset to binary '1001' (i.e., decimal 9) and give a carry-out when zero is reached. Since the system is required to be fully synchronous to function properly, all carry-in signals to the decade counters are ANDed with all the carry-out signals from the preceding stages.

(The exception being the first stage, which has its carry-in permanently set.) This provides a carry look-ahead scheme, which avoids ripple carry delays. This is not shown on the block diagram.

The effective internal clock is derived from the decade counters by a logic function that represents a selector switch SELCLK. The internal clock can be selected independently for both the initial delay portion of the pulse and for the pulse itself, on separate DIP switches.

The octal counter is an eight-stage binary counter with a synchronous parallel preset input. The count down is complete when the counter reaches a count of 1, rather than a count of zero. It is necessary to sense the condition '01' hex rather than zero since the synchronous circuitry will only respond at the next clock edge, thus effectively taking the extra clock cycle.

Sensing the zero condition would result in one extra count. The extra count would be confusing, since the count would not correspond to the DIP switch settings. The function LIMIT goes true when this condition is reached and the decade counters have completed their count down.

**TABLE 2: Rate and Delay settings**

| FUNCA/B setting | Eff. Clock Frequency | Period |
|---|---|---|
| 000 | 20MHz | 50ns |
| 001 | 2MHz | 500ns |
| 010 | 200kHz | 5us |
| 011 | 20kHz | 50us |
| 100 | 2kHz | 500us |
| 101 | 200Hz | 5ms |
| 110 | 20Hz | 50ms |
| 111 | 10Hz | 100ms |

The control state machine has five states, arbitrarily labelled C0 to C4. C0 is the reset or rest state; C1 defines the delay part of the pulse; C2 defines the pulse itself; C3 provides for the case where a trigger input is still present, to ensure that only one pulse is generated in one-shot mode per trigger pulse; and C4 is the stopped state for the one-shot mode. The labels for the states can be used directly in logic equations where needed.

## In operation

When the system is reset, the state machine will step to the C1 state when either the START switch is pressed, a trigger pulse is received or the system is

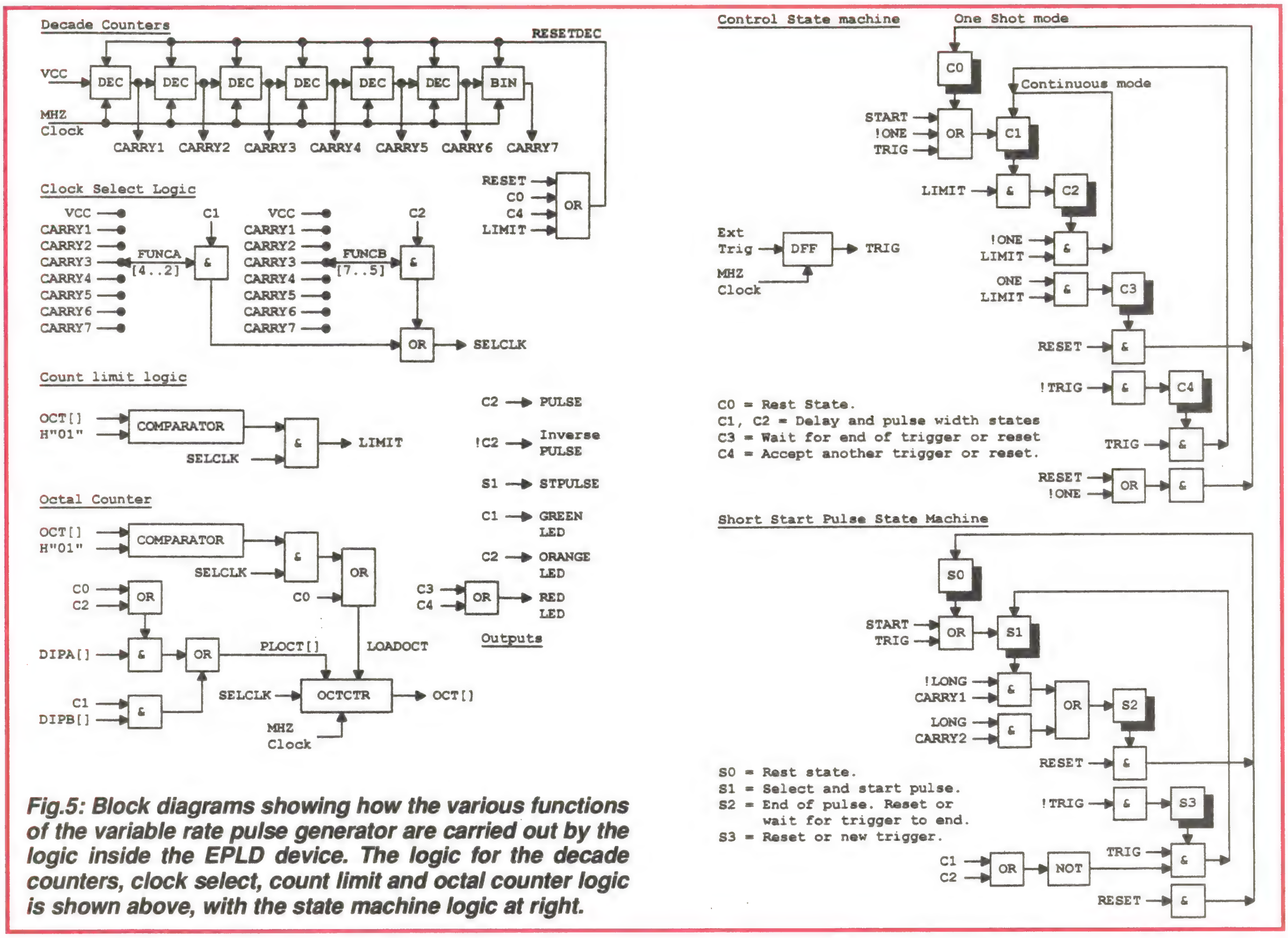


*Fig.5: Block diagrams showing how the various functions of the variable rate pulse generator are carried out by the logic inside the EPLD device. The logic for the decade counters, clock select, count limit and octal counter logic is shown above, with the state machine logic at right.*

put into the continuous mode by setting switch 1 on the function DIP switch. Whilst in the C0 state the decade counters are held reset to all 9's. Also LOADOCT is true, so that the octal counter is held loaded with the count set on octal DIP switch A, through function PLOCT[] (Parallel Load Octal counter). The required internal clock is set by function SELCLK as selected on the function DIP switch positions 2, 3 and 4.

When state C1 is entered, all counters are ready to count down through their full count, to define the delay preceding the pulse. When the octal counter has counted down to 01H and the next carry signal from SELCLK occurs, the state machine switches to state C2. This condition is registered by logic function LIMIT.

The same condition causes the octal counter to be reset to the next count as set on octal DIP switch B, through function PLOCT[] and the required internal clock is selected from the function DIP switch positions 5, 6 and 7. At the same time the decade counters are reset to 9's by signal RESETDEC. The octal counter will then count down to 01H again, thus defining the pulse width.

The state machine will then switch to state C3 in the one-shot mode, or to C1 again if the continuous mode is active. For the continuous mode the whole procedure simply repeats indefinitely.

In the one-shot mode the state machine remains in state C3 until either the trigger pulse is removed — in which case state C4 is entered — or the RESET button is pressed, in which case the reset state C0 is entered. If the state machine is in state C4 a new trigger pulse can start another pulse sequence or the RESET button can reset the state machine to the reset state C0.

Note that the parallel load for the octal count occurs at the end of the preceding step in the state machine sequence. Consequently if a new trigger pulse is received, the octal counter is already set up for the first part of the next pulse sequence.

The output pulse is defined by state C2. The state machines have been organised to change state according to a Gray code, to ensure that there are no glitches in output signals.

The short start pulse state machine has four states labelled S0, S1, S2 and S3. Once again S0 is the reset or rest state. S1 defines the width of the pulse, which can be either 0.5us determined by CARRY1, or 5.0us determined by CARRY2. The input switch has the name LONG and is on the function DIP switch at position 2.

```
Title "Decade counter";
%
  File name: DECADE.TDF
%
SUBDESIGN DECADE
(
CLOCK, RESET,
CIN                 : INPUT;  % Carry in  %
COUT                : OUTPUT; % Carry out %
)
VARIABLE
R[3..0]             : DFF;    % BCD counter %
BEGIN
    % Set up BCD counter %
    R[].clk        = CLOCK;
    IF RESET OR (R[] == 0) AND CIN
        THEN       R[] = (1, 0, 0, 1);
    ELSIF CIN
        THEN       R[] = R[] - 1;
    ELSE           R[] = R[];
    END IF;
    COUT    = (R[] == 0);       % Carry out %
END;
```

*Fig.7: Another sample, showing the logic for the decade counter.*

State S2 is entered when the pulse is finished. The state machine remains in state S2 until either the trigger pulse is finished, or the RESET button is pressed. When the state machine is in state S3 a new start pulse can be triggered provided the main pulse is not active. Alternatively pressing the RESET button at this point will reset the state machine to state S0. The start pulse is defined by state S1.

## AHDL source code

Full details of the source code will not be given here. However, two examples from the source code are shown, as examples of what can be achieved. The first example in Fig.6 shows the clock select logic, while the second example in Fig.7 shows the decimal divider logic.

In these listings the ampersand symbol (&) represents the logic AND function. The logic OR function is represented by the number symbol '#'. Inversion is represented by the exclamation mark '!' and comments are enclosed in percent symbols. Logic statements can span any number of lines and are terminated in a semicolon.

To achieve synchronous carries, each CARRY function has to include carry-out signals from all previous counter stages. Carry-out signals are designated by appending '.cout' to the variable names of the counters as defined in the logic for the decade counters.

Note that the final counter was a simple binary counter and not a full decimal counter stage, due to the desire to achieve the maximum functionality available.

In the statement for the logic function 'SELCLK' (Fig.6), FUNCA[] and FUNCB[] are two sets of three switches on the function octal DIP switch. C1 and C2 are the two states of the control state machine, representing the space and the mark of the pulse, and the CARRYn functions are as defined above. Function SELCLK is assigned to a macrocell.

Expressions such as (FUNCA[] == B"000") are conditional expressions. They are interpreted as meaning logic true when FUNCA[] is set to the binary value given (000 in this case). This is a simpler way of writing the AND function !FUNCA4 & !FUNCA3 & !FUNCA2, and is an easier way to see what is required. An obvious advantage of the EPLD is the ease with which a function of the sort shown in Fig.6 can be implemented.

Fig.7 shows the logic for the decade counter. This is defined as a separate function. All inputs and outputs are

```
% Look ahead carry logic %
CARRY1          = DEC0.cout;
CARRY2          = DEC1.cout & DEC0.cout;
CARRY3          = DEC2.cout & DEC1.cout & DEC0.cout;
CARRY4          = DEC3.cout & DEC2.cout & DEC1.cout & DEC0.cout;
CARRY5          = DEC4.cout & DEC3.cout & DEC2.cout & DEC1.cout &
                  DEC0.cout;
CARRY6          = DEC5.cout & DEC4.cout & DEC3.cout & DEC2.cout &
                  DEC1.cout & DEC0.cout;
CARRY7          = BIN.cout  & DEC5.cout & DEC4.cout & DEC3.cout &
                  DEC2.cout & DEC1.cout & DEC0.cout;

% Clock select logic for Variable Octal Counters %
SELCLK          =  C1 & (FUNCA[] == B"000")
                 # C1 & (FUNCA[] == B"001") & CARRY1
                 # C1 & (FUNCA[] == B"010") & CARRY2
                 # C1 & (FUNCA[] == B"011") & CARRY3
                 # C1 & (FUNCA[] == B"100") & CARRY4
                 # C1 & (FUNCA[] == B"101") & CARRY5
                 # C1 & (FUNCA[] == B"110") & CARRY6
                 # C1 & (FUNCA[] == B"111") & CARRY7
                 # C2 & (FUNCB[] == B"000")
                 # C2 & (FUNCB[] == B"001") & CARRY1
                 # C2 & (FUNCB[] == B"010") & CARRY2
                 # C2 & (FUNCB[] == B"011") & CARRY3
                 # C2 & (FUNCB[] == B"100") & CARRY4
                 # C2 & (FUNCB[] == B"101") & CARRY5
                 # C2 & (FUNCB[] == B"110") & CARRY6
                 # C2 & (FUNCB[] == B"111") & CARRY7;
```

*Fig.6: This sample of the AHDL source code for the generator EPLD shows the clock select logic for the variable octal counters.*

# DIGITAL PULSE GENERATOR USING AN ALTERA EPLD - 2

declared first, enclosed in brackets ( ). Then the variables for the counter flip-flops are declared as D flip-flops (DFF). This is conveniently achieved using the group notation enclosing the range of numbered variables in square brackets. Logic statements are enclosed in the BEGIN and END keywords. The clock signal is assigned in the group statement R[].clk = CLOCK; the full range of numbered variables being understood.

The entire function of the counter is defined with the IF statement, which says that if the RESET input is active or the count reaches zero AND there is a carry-in present, then the counter will be reset to decimal 9. Else if there is a carry-in, the counter will decrement. Importantly, if there is no carry-in at this stage, the counter retains its present state. Finally there is a carry-out whenever the state of the counter is decimal zero.

The use of the arithmetic -1 is a specially provided way of defining counters in the Hardware Description Language of the Altera system. This is an alternative way of defining a state machine representing a counter. (Other arithmetic operations can also be implemented).

## Implementation details

The complete circuit for the project is given in Fig.8. Most of the circuitry is to do with the inputs and outputs. The single in-line resistor packs take care of pull-up resistors for the DIP switches. The value of the pull-up resistors is uncritical; any value up to 100k will do. Pull-down resistors R8 and R9 ensure that uncommitted inputs are not left floating.

Decoupling capacitor C6 has been provided in case a non-digital source of external reference frequency is used. The crystal oscillator module requires only VCC and GND to generate the clock signal. A three-pin jumper provides a switch for selecting the internal or an external source of clock frequency. Configuration options for inputs and outputs on the 16-pin header can be seen in the circuit diagram.

The 50-ohm termination should be used for the external trigger pulse.

Two units were required for testing the design, since a pulse stream was required to drive the trigger input to observe the short start pulse output on an analogue oscilloscope. This was the only hope for seeing this pulse in one-shot mode, with the available test equipment.

## Pulse rate, duty cycle

In order to determine DIP switch settings for required pulse rates and mark to space ratio, refer to the circuit diagram or Table 1 for the functions of the DIP switches. Note that the individual DIP switches have been arranged so that a switch represents a logic '1' when it is pressed ON or up (i.e., towards the centre of the PC board).

Then if a 20MHz crystal oscillator

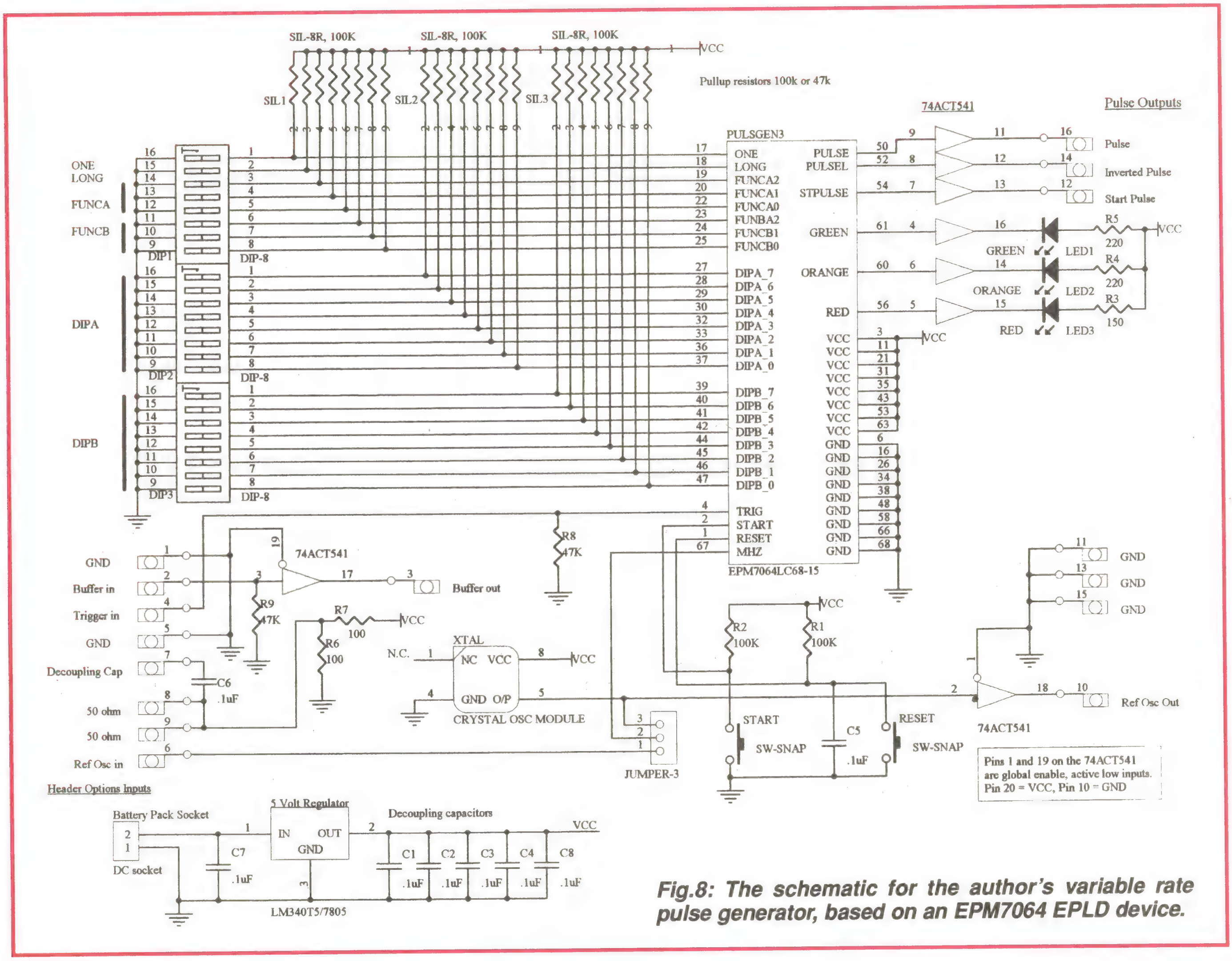


*Fig.8: The schematic for the author's variable rate pulse generator, based on an EPM7064 EPLD device.*

module is in use, frequencies of SELCLK and periods given by FUNCA and FUNCB DIP switches are given in Table 2. Multiply the value in the period column for the setting of FUNCA by the setting of DIPA (in hexadecimal) for the space between pulses and multiply the value in the period column for the setting of FUNCB by the setting of DIPB (in hexadecimal) for the pulse width. The reciprocal of the sum of the two is the frequency. (Microsoft Windows has a handy calculator that can do hexadecimal to/from decimal conversions).

Work back the other way for a required frequency. That is, take the reciprocal of the desired frequency to get the period, then set the sum of the switch settings to get close to this value. Note that some frequency counters may not function properly if a highly asymmetrical mark/space ratio is selected.

DIPA or DIPB set to all zeros is equivalent to setting them to 256. Consequently FUNCA set to 7H and DIPA set to 256 (0H) is equivalent to a setting of 25.6 seconds, with a resolution of 100ms. Setting FUNCB to 0H and DIPB to 1H will result in a pulse width of 50ns with a resolution of 50ns, as stated in the example at the beginning of the article.

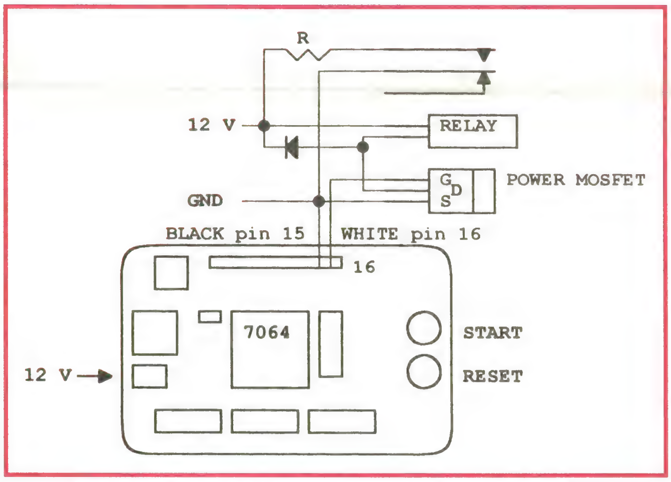


***Fig.10: The circuit used by the author for testing a relay using his variable pulse generator.***

## Construction

The PCB overlay diagram is shown in Fig.9, along with a 'top layer' pattern purely to serve as a guide when fitting the links to the top of the board. (The PCB is single sided.)

After etching and trimming the card, all the holes have been drilled with a 0.8mm drill. The holes for the regulator, the three-pin jumper, the 16-pin header and the START and RESET switches require enlarging with a 1.0mm drill. Larger holes are required for the DC battery pack socket and the heatsink mounting hole. The DC battery pack socket holes can be made slightly undersized and elongated with a small round file.

There is one unused earth pad near the top left hand side of the PCB. Check that all IC sockets, the DIP switches and the SIL resistors fit properly. If there is a problem with fit, enlarge holes to 1.0mm.

When the PCB is ready, insert short lengths of wire (these may be uninsulated) for all short links. In particular there are three links under the 68-pin PLCC socket. Make sure that these links are soundly connected and soldered before mounting the 68-pin socket. The three longer links requiring insulated wire can be left until later. When inserting the 68-pin socket, make sure that the bevelled corner is correctly orientated.

The assembly order is based on the idea of mounting the flattest things first, then the next flattest things, etc. Finishing up with the highest profile parts.

Next mount the 0.25W resistors, then the three IC sockets, then the DIP switches and the SIL resistors. For each of these components, solder one corner or end first and make sure that these components are fully inserted flush before soldering the remainder. Orientate the DIP switches with the ON position towards the middle of the board, and the SIL resistors with the black stripe end on the square pad.

The regulator and its heatsink can go in next, followed by the DC input socket. The pins on the regulator have to be bent at 90° before inserting the leads. A dab of heatsink compound under the regulator helps efficient heat transfer. Total current drawn is about 140mA, so there is no problem with heat dissipation.

Solder in the capacitors, the 16-pin header and the LEDs. Monolithic 0.1uF decoupling capacitors can be used in all positions. Refer to the overlay and top

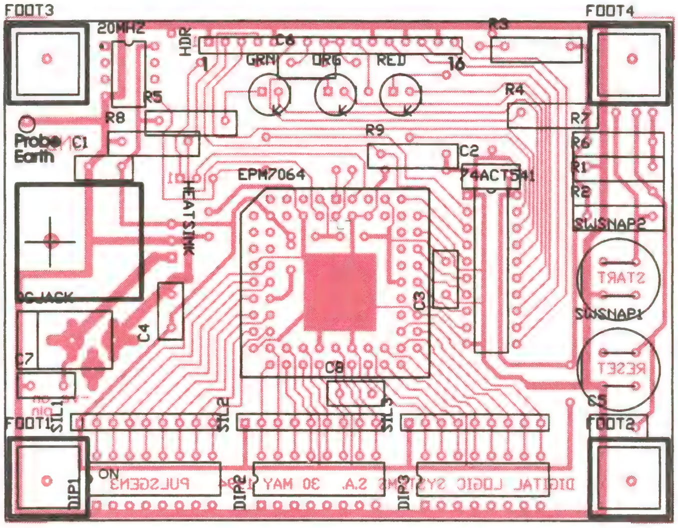


***Fig.9(a): The overlay diagram for the pulse generator printed circuit board, showing the components locations.***

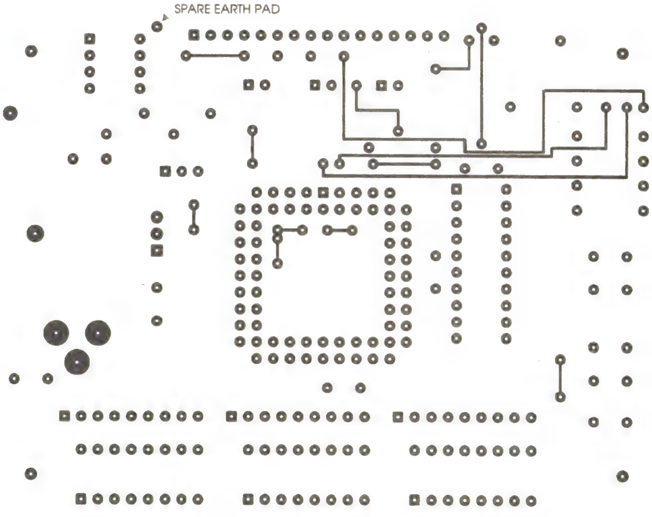


***Fig.9(b): Although the PCB is only single sided, this 'top layer' plot shows where the links are fitted.***

layer drawings for the positions of resistors, capacitors and links.

At this point the remaining insulated wire links can be soldered in place. Since these wires have to thread between other components, they do not get in the way if left to this point.

Finally, mount the three-pin jumper header and the single pin jumper header for the oscilloscope earth clip used for testing. It is good practice to check all solder joints with a magnifying glass.

Before inserting the active components in their sockets, check that power is appearing in the correct places and at 5.0V when power is applied to the DC input socket. (Make sure that the battery pack lead has the negative lead on the pin of the socket. Also there are two sizes available for these connectors, 2.1mm and 2.5mm — make sure that the connector on the lead matches that on the PCB.) The battery pack voltage should be set for say 7.5V, to ensure that the regulated 5V is free of ripple.

Note that the 50-ohm termination will put 200 ohms across the power supply rail.

After removing the power, insert the two ICs and the crystal oscillator module. When inserting the 68-pin EPM7064, make sure that the bevelled corner of the device is aligned with the bevelled corner of the socket and that it is square with the socket before pressing it in. Place the jumper on pins 2 and 3 of the three-pin jumper header to connect the internal oscillator module.

## Testing

To test the unit, set the DIP switches to give pulse times of a good fraction of a second and for continuous mode of operation.

On applying power, the green and orange LEDs should toggle, indicating that the unit is operating. Connect an oscilloscope and observe the output waveform. Have a look at the 50ns pulses on the highest frequency position. Try a range of settings. If this output is unterminated, a small amount of ringing can be seen at the top and bottom of the pulses. This should not be a problem for most applications.

### TABLE 3:
### 16-pin Header Connections

| Pin | Function |
|---|---|
| 1 | Earth |
| 2 | Input to spare buffer (TTL level) |
| 3 | Output of spare buffer (TTL or 5V CMOS level) |
| 4 | Trigger signal input (TTL level) |
| 5 | Earth |
| 6 | Ext. Ref. Oscillator input (optional) (Jumper link 1-2 for an external oscillator, Jumper link 2-3 for the internal oscillator) |
| 7 | Spare decoupling capacitor input side |
| 8,9 | Decoupling capacitor output, 50-ohm termination |
| 10 | Internal reference oscillator buffered output. |
| 11 | Earth |
| 12 | Synchronous start pulse, buffered (one-shot mode only, TTL or 5V CMOS level) |
| 13 | Earth |
| 14 | Buffered pulse output inverted (TTL or 5V CMOS level) |
| 15 | Earth |
| 16 | Buffered pulse output positive going (TTL or 5V CMOS level) |

Switch to one-shot mode and press the reset button. The three LEDs should be off. Then press the Start button to trigger a single pulse sequence. The green, orange and red LEDs should flash in turn, and should end with the red LED on.

Press the reset button to ready the unit for another pulse. To test the external trigger input requires an additional source of pulses. Borrow a second PULSGEN unit from a friend to provide the source of pulses. Set the second unit to continuous mode, with a longer period for the pulses. The short start pulse can be seen in this mode. Try out a few configuration combinations with the 50-ohm termination and the spare buffer. The unit is now ready for use.

Applications for the pulse generator can include driving a circuit repetitively to observe its performance on an analog oscilloscope; providing a precise pulse to drive a relay for timing a short duration process; or providing a pulse to simulate a signal from an external source, etc.

The circuit used by the author to test a relay is shown in Fig.10. The additional components connect to the pulse generator board via pins 16 (pulse out) and 15 (Gnd) of the 16-pin header. A separate 12V DC source is needed to drive the circuit. The author attached his oscilloscope to the resistor and the oscillosope trigger lead to the diode-relay-MOSFET drain junction, to observe relay response and contact bounce period. The generator was of course set for a suitable pulse rate for driving the relay.

## Kit availability

Kits for this project are available from Digital Logic Systems, of PO Box 647, Elizabeth SA 5112; phone (08) 255 2953. The price of the full kit (not including plug pack power supply) is $95.00 plus $4.00 postage (Australia Parcel Post). Add $50 if you wish to have the kit assembled. Please allow up to four weeks for delivery. Phone or write for special requirements.

Further information on Altera EPLD devices is available from the Australian distributor Veltek Pty Ltd, of 18 Harker Street, Burwood 3125; phone (03) 808 7511. ❖

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# New Stereo TV Sound Receiver - 1

*Continued from page 61*

put, while U3b is then used as a simple unity-gain inverting buffer to produce an opposite-phase version of the same signal, for optionally driving a spare stereo amplifier in bridge mode.

The power supply section of the receiver is fairly conventional, and uses a readily available 30V/500mA transformer with a centre tap and also taps at the 7.5V points. Here we use a bridge rectifier across the full winding, to produce raw DC outputs of +/-21V, and these are passed through a 7812 regulator (U4) and a 7912 regulator (U5) to produce the main +/-12V rails needed by the receiver circuitry.

The +9V supply required by the tuner module is then derived from the +12V rail, using a 7805 regulator (U6) 'bootstrapped' with a 4.7V zener diode. Similarly the +5V supply needed by the TDA3857 chip is derived by another 7805 regulator (U8), again from the mail +12V rail.

The remaining supply voltage needed in the receiver is the well-regulated +28V for the tuner module's varicap tuning, and I've had to be a bit 'sneaky' to provide this in an economical fashion, using the transformer concerned.

The basic arrangement here is a half-wave voltage doubler, as you can see, using diodes D7 and D8 in conjunction with capacitors C25-26. But the configuration is slightly unorthodox, as the doubler works with an asymmetrical AC input — because of the way that D7 is connected to the +21V rail, while capacitors C25-26 are returned to a 7.5V tap on the transformer.

During one set of half-cycles, when the transformer tap goes negative, C25-26 charge up to around +31.5V: equal to the sum of +21V (applied to one end via D7) and the peak negative value of 7.5V RMS, or -10.5V (applied to the other end by the transformer). Then during the alternate half-cycles, when the transformer tap goes positive, this charge plus another +10.5V from the transformer can be transferred via D8 and R12, and used to 'top up' the charge in capacitors C27-28.

As you can see, this system has the potential to charge up C27-28 to around 41.5V; but the capacitors concerned (selected for their low cost) have a working voltage rating of only 35V. As it happens, the LM723 regulator U7 also has a maximum input rating of 40V. So the voltage across the capacitors has to be prevented from reaching 41.5V, and in fact limited to less than 35V.

This is the purpose served by resistor R12 and zener diode D9, which together form a simple pre-regulator ahead of the capacitors. R12 limits the peak current through the zener, while the zener itself limits the capacitor voltage to around +33V (+21V plus the nominal 12V zener voltage). This 'raw' DC supply is then fully regulated to the final +28V level for the tuning voltage supply, by U7. The regulator is used in standard fashion, with preset pot RV7 used to set the +28V rail to its correct level.

That's the circuit of the new Stereo TV Sound Receiver, then. In the second of these articles we'll describe how you can build it and get it going.

(*To be continued.*) ❖

# Dry Cell Charger

*Continued from page 75*

Note that a DC plug pack is NOT suitable.

The artwork for the front panel will suit both size plastic boxes, although the location holes for the screws suit the smaller size case. To make a front panel, photocopy the artwork, then spray it with a suitable lacquer (available from most hardware shops).

When the lacquer is dry, spray contact glue on the lid, then carefully place the artwork on the lid. This method gives a durable, yet cheap, front panel.

Use the guide holes to drill the panel, one hole for the switch and another for the LED. Fit a plastic bezel for the LED. The PCB is held to the lid by the switch and the LED pokes into the bezel. Check that the heatsink is not touching the lid before tightening the nut for the switch.

## Using the charger

From the tests we've conducted so far, alkaline dry cells rather than conventional dry cells are best for recharging. The cells should have a terminal voltage around 1.0V or more to take a successful charge. There is nothing special about NiCads, as the charger simply charges these cells at their C10 rate. As usual with NiCads, to avoid the memory effect don't recharge them until they are virtually flat.

**By the way, do NOT try to use this charger to recharge lithium cells. Also, when charging cells in series, they should all be of the same size and type — and preferably, in the same state of discharge.**

The charger is designed to work with battery packs up to 6V, although it's possible it might effectively charge higher voltage packs, say up to 7.2V.

If you want to charge a 6V lantern battery, try the 'C & D' setting. If this doesn't charge the battery, you might need to increase the charge/discharge currents by changing the values of a pair of resistors selected by SW1. We have done no research for these batteries, but as a guide, use a one ohm resistor for those selected by SW1a and 6.8 ohm resistor for those with SW1b. If you change these resistors, check that transistor T3 is not getting too hot.

Next month we hope to bring you the results of our research into the effectiveness of recharging dry cells. In the meantime, it's clear from our present tests that you won't be wasting your money if you build this charger. ❖

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**Regards, Jack O'Donnell**

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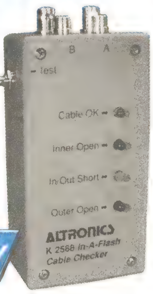

**(See EA November '94)** Here's a really handy little device for anyone working with a lot of coaxial and shielded cables used to carry video, audio or data. To check a cable, all you need do is connect both ends to the checker and press the button. Instantly one of four LED's will glow, to show it's condition - much faster then doing the job with a multimeter. It uses only a handful of low cost parts, and can be assembled in a couple of hours.

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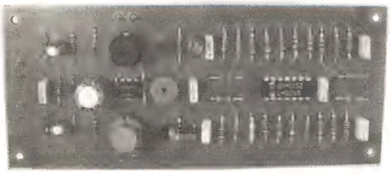

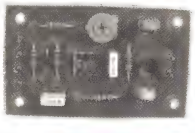

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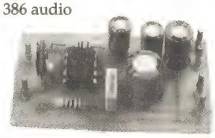

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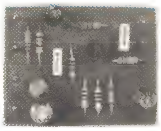
## Pre-Champ Pre-Amp Kit

**(See SC July '94)** This kit has been designed to compliment the Champ amplifier kit K 2115 (above), which when combined boosts overall gain to significantly high levels. Will amplify low level microphone to line level etc.



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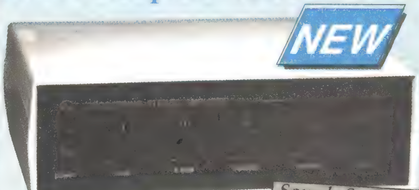

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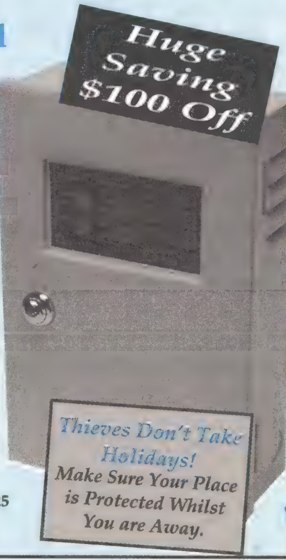

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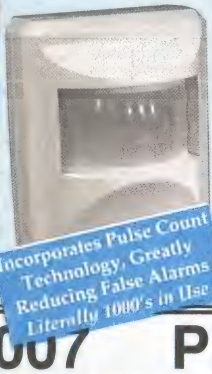

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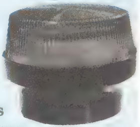

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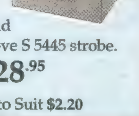

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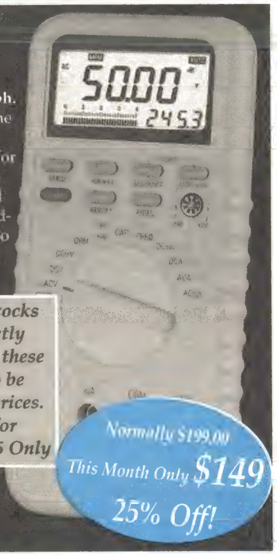

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**AC Current:**.....0.1µA-20Amp ± 1.5%
**Resistance:**..............0.1Ω-40MΩ ±0.8%
**Frequency:**..............1Hz-2MHz ±0.5%
**Capacitance:**............0.1nF-100µF ±3%
**Diode Test:** ..1mA forward DC current
**Continuity:**..........................................<30Ω
**HFe:**............Base current ≈1µA VCE 3.0V
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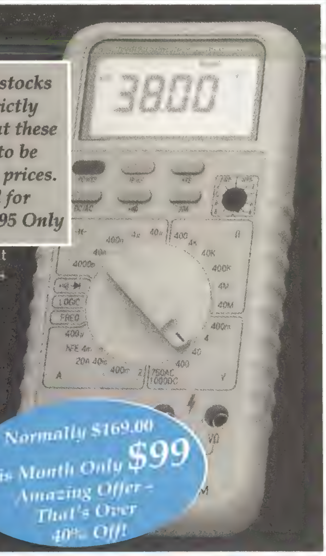

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**AC Voltage:**.........100µV-750V ±0.8%
**DC Current:**.....0.1µA-20Amp ± 1.0%
**AC Current:**.....0.1µA-20Amp ± 1.5%
**Resistance:**..............0.1Ω-40MΩ ±0.8%
**Frequency:**..............1Hz-4MHz ±0.5%
**Capacitance:**..............10pF-4µF ±5%
**Diode Test:** ..1mA forward DC current
**Continuity:**..........................................<30Ω
**HFe:**............Base current ≈1µA VCE 3.0V
**Display Size:**..............15 x 8mm per digit

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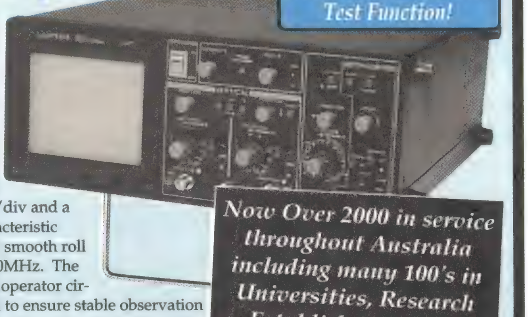

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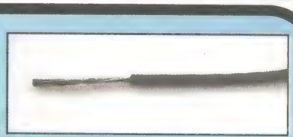

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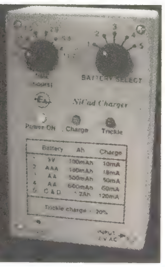

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Doc.JH088

# SHORTWAVE LISTENING

with
Arthur Cushen,

## Interesting summer listening

The rapid decline of sunspots is forcing stations to use lower frequencies, and the move to winter and daylight time in many countries has resulted in international broadcasters being heard on new channels and at new times. In the survey that follows, we cover most of the best received signals. All broadcasts are in English unless otherwise stated.

**ABU DHABI:** Radio Abu Dhabi, located on the Persian Gulf and capital of the United Arab Emirates has regular broadcasts from 2200UTC on 9605, 9770 and 11,885kHz.

**ALASKA:** KNLS, Anchor Point has made a frequency change and now uses 7365kHz for its English broadcast 0800 - 0900 beamed to Asia. Most of the other transmissions are in Mandarin and Russian.

**AUSTRIA:** Vienna in their service to the South Pacific is broadcasting at 0830 - 0900 on 15,450, 17,870kHz. Additional programmes are 0103 - 1100 on the same frequencies.

**BHUTAN:** Thimpu is heard with English 1415 - 1500 on 5025kHz and using a power of 50kW. Broadcasting from high in the Himalayas, it provides a challenge to radio listeners.

**COLOMBIA:** Caracol Network, Bogota using 5075 and 6150kHz has a special programme on Sunday 0530 - 0600 for its international audience. There are some English announcements and the feature continues through to 1000UTC with this new international service.

**CROATIA:** Zagreb has several sessions in English, with recent use of 13,640kHz, in addition to the normal channel of 13,830kHz. It is heard around 2000 with English after 2200.

**GERMANY:** Broadcasts from Cologne to this area are heard in two daily transmissions: 0900 - 0950 on 6160, 12,055, 17,780kHz and for our morning reception 2100 - 2150 on 9670 and 11,785kHz.

**GREECE:** Athens' latest schedule has English at 0340UTC on 9420 and 9935kHz. The earlier transmission is in Greek and this programme is directed to North America, but there is fair reception in the South Pacific.

**GUAM:** KTWR has English to the South Pacific 0855 - 1000 on 11,830kHz, to the Far East 0800 - 0915, 15,200; to South Asia 1500 - 1615 (to 1630 Wednesday - Sunday) on 11,580kHz.

**HAWAII:** KWHR's latest schedule is 0000 - 0400 on 17,510kHz; 0400 - 1600 on 9930kHz; 1600 - 1800 on 6120; 1800 - 2000 on 13,625; 2000 - 2200 on 11,980; and 2200 - 2400 on 17,510kHz. The transmission is a permanent relay of WHRI, South Bend, Ind.

**HOLLAND:** Radio Nederland has some new frequencies with English to the Pacific 0730 - 0835 on 9720 and 11,895kHz (Bonaire); 0830 - 0925 on 9720 (Bonaire) and 13,700kHz (Irkutsk, Siberia); 0930 - 1025 on 9720 (Bonaire), 7250 (Petropav, Kazakhstan) and 9810kHz (Irkutsk).

**JAPAN:** Radio Japan's service to Australasia is in English at 0900 - 1000 on 15,270kHz and the General Service to this area is 0700 - 0800 on 15,270; 1900 - 2000 on 7140, 11,850; 2100 - 2200 on 11,850; and 2300 - 0000 on 11,850kHz.

**KOREA:** Radio Korea International is the new slogan which took effect on the occasion of its 41st birthday and the opening of a new 250kW transmitter. The English broadcasts are relayed by the BBC at 2030 on 5965kHz and by RCI at 1030 on 11,715kHz.

**MONACO:** TWR Monte Carlo in English is scheduled for 0740 - 0920 on 7110kHz daily; Saturday to 0935, Sunday to 0945.

**NORWAY:** Oslo broadcasts in English on Sundays only to Australia and NZ 0800 - 0830 on 11,735 and 15,175kHz; 1900 - 1930 on 7215, and to Australia 0900 - 0930 on 17,740; 1200 - 1230 on 11,850 and 15,165kHz. Norway is moving out of band and is using 9480kHz at 1500; at 0100 they are on 5900 and 5905kHz; at 2000 and 0500, 5905kHz.

**NEW ZEALAND:** RNZI Wellington's schedule to March 19 1995 is 1650 - 1850 on 9655kHz Monday - Friday; 1851 - 2050 on 11,735; 2051 - 0715 on 15,115; and 0716 - 1206 on 9700kHz. There is some slight difference in sign off on Saturday and Sunday to accommodate relays from National Radio. The frequency of 9655kHz is used between 1205 and 1650 when there are special sporting relays.

**SAIPAN:** KHBI's latest schedule to the South Pacific in English is 0800 - 1000 on 13,615kHz; 1000 - 1100 on 13,625; 1100 - 1300 on 9425; 1300 - 1400 on 9355; 1800 - 1900 on 9355; 2100 - 2200 on 13,840; and 2300 - 2400 on 13,625kHz.

**SOUTH AFRICA:** Channel Africa has English from 0300 - 0500UTC on 5955 and 9585kHz; and 0500 - 0600 on 7185, 11,900kHz.

**SWITZERLAND:** SRI beams to the Pacific in English at 0900 - 0930 on 9885, 13,685, and 17,515kHz from Switzerland; and from the new base in French Guyana they are using 11,640kHz. A reply indicates that the station will not verify reception reports unless it is over a period of several days.

**TURKEY:** Ankara at 2300 and 0400 has English on 9445kHz. The other frequencies in use at 2300 are 7185 and 11,710kHz.

**UNITED KINGDOM:** BBC World Service is on three new channels: 15,350kHz at 0500 - 0915, 15,340 at 2300 - 2400; and 15,280kHz at 0915 - 1015. The regular World Service at 1800 - 2200 is on 9740 and 11,955kHz; at 2200 - 2300 on 11,695kHz via Radio Australia; and 2300 - 2400 on 15,340kHz. During our evenings from 0600, it is on 9640, 11,955 and 15,350kHz. After 0900, on 15,280kHz; from 1000 on 9740; and from 1100 on 9700kHz which is a relay from RNZI Wellington for 30 minutes. During the night time listening 9740kHz provides the best reception.

**YUGOSLAVIA:** Belgrade is heard well in English at 2100 - 2130 on 7265 and 9595kHz, beamed to Australia. It is also operating to Europe on 6100KHz, Africa on 9720 and North America on 9580, 11,870kHz. Other transmissions announced are 1830 on 6100 and 9740kHz, 2030 on 9620kHz and 0430 on 9580, 11,870kHz.

This summary of reception of many broadcasts will be continued next month when further stations will be published with their latest schedule and frequency list.

### Transmitter history

A Belgium listener has taken on an interesting project to research shortwave transmitters — including how many transmitters there are at each site, the manufacturer of the transmitter and when they were installed.

The booklet, called 'Transmitter Documentation Project' gives the reader some idea of the huge megawatts of power transmitted each day into the ionosphere. Its 52 pages contain listings of 192 countries, and although many have no shortwave transmitters, some 141 countries have at least some shortwave voice.

Transmitters with powers of less than 10kW are not included and one can imagine the difficulty in getting data from some countries, particularly the former Soviet Union. There are tables showing a break-down of transmitter power; one shows the number of 500kW transmitters (some 245 are listed), and these of course are mainly in Europe and North America. There are 558 transmitters in the power range of 100 - 200kW, which would include many of Radio Australia outlets and Radio New Zealand International.

The author of this publication is Ludo Maes and he plans to update in the coming months.

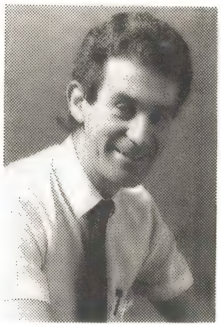
### Number stations located

One of the mysteries of shortwave listening over the past 40 years has been the so called 'Number Stations' which broadcast in English, German and Spanish, a series of numbers in coded form, or alphabetical letters. These have been heard on many frequencies.

In past years the German speaking stations have disappeared and so have the English ones. This suggests that they were part of some Intelligence Operation in Europe. However a recent issue of Monitoring Times revealed that many of the Spanish speaking broadcasts were actually operated by the US Central Intelligence Agency, as part of a drug investigation.

One of the sites is at Warrenton in Virginia, and houses the four digit Spanish spy/drug number broadcasts. Larry van Horn has spent years of investigation into this undercover operation and has finally provided shortwave listeners with some information on the reasons for these broadcasts. They appear all over the dial and one of the regular transmissions in Spanish is on 9405kHz around 0400. However frequencies and times are subject to change, so that the field agent is the only one with prior knowledge of the operating schedule. ◆

*This item is contributed by Arthur Cushen, 212 Earn Street, Invercargill New Zealand who would be pleased to supply additional information on medium and shortwave listening. All times are quoted in UTC (GMT) which is 11 hours behind Australian Daylight Time and 13 hours behind NZ Daylight Time.*



# Information centre

Conducted by Peter Phillips

## Troubleshooting, sprays and a paradox

There's a servicing and repair flavour this month, with several readers describing troubleshooting experiences and giving servicing hints. As well, there's a description of how to use a frypan to remove PCB components, comments about motor/generators, a discussion of the folded dipole and so on.

One of our most popular sections is The Serviceman column, where servicemen (service persons?) describe equipment faults and how they were found. And sometimes I include stories in Information Centre that have a Serviceman feel, but with the difference that the stories are generally from readers who confess to being either technically illiterate or an amateur in the electronic repair business.

In most cases the fix involves something mechanical or temperature related.

For example, you might remember the hard disk that came good after its non-technical owner put it in the freezer. He did this after noting that the unit worked when taken to the service centre's air-conditioned workshop.

All too often clues abound that we technical types tend to overlook — perhaps a case of not seeing the wood for the trees. Certainly putting a hard disk in the freezer is not a way to repair it, but it would at least allow files to be copied from it before the real repair was done involving a reformat.

My point is that quite often a fault can be found by noting *everything*, not just the symptoms. For example, what's likely to be wrong with an appliance if it works when it's cover is removed? Our first contributor explains...

### VCR repair

This letter comes from a regular contributor to these columns:

*I'd been having trouble with my Sharp 381 VCR, an old model where I think 38 means 1983. After about half an hour it would switch itself off and if I tried to restart it, it would run for a short period whose duration varied with the length of the spell it had been given.*

*Repeated efforts by a local (here this means 20 kilometres away) technician were fruitless, so I thought I'd have a go. I ran the VCR until it stopped and then removed its cover. The machine then ran for a short while and stopped again. This time, before restarting it, I applied a cooling fan to the works, as the symptoms appeared to be temperature related. All was now well and the VCR ran normally.*

*I removed the fan and operation continued for several hours. Nothing appeared to be unduly warm, so I replaced the cover. After 10 minutes the VCR cut out and I repeated the cover-off run; this time after a few minutes spell to allow its temperature to cool and stabilise. Success again. Clearly the cooling was inadequate and since nothing was uncomfortably hot, I suspected that the cooling design was tight and that maybe some temperature-sensing device on the heatsink had become too sensitive as the years passed.*

*It thus seemed that extra cooling could be in order. I considered a small fan but this presented control problems. As air entry around the heatsink looked a bit miserable, I cut a large rectangle, about the size of the heatsink, out of the back of the plastic cover and covered the cutout with a piece of coarse plastic grille.*

*Of course, I've treated the symptom, not the disease, but the provision of extra ventilation is hardly likely to be harmful. Lacking even a circuit diagram I'm not about to try to find and replace the touchy component. But why did the technician miss out?*

Of course, with the cover off the *problem disappears, but he should have woken up. Maybe it's significant that his shop is now closed!* (Ron Voller, St Georges Basin, NSW.)

I suppose, Ron, that many readers are now wondering how long the VCR will keep going with your 'fix'. It's surprising the technician tried to faultfind the VCR in your home, although the 20km distance might be a factor. In most cases, an intermittent fault can only be serviced economically in the workshop, where test equipment can be attached to monitor the appliance's behaviour.

Your story reminds me of another, where a lady rang her local serviceman asking for someone to replace the battery in her (valve type) TV set. The serviceman agreed diplomatically, but later had to agree the lady was right. It turned out that sometime in the past a repairer had found that the fault disappeared when an ohmmeter was connected to a particular part of the circuit. A simple and effective solution was to connect a 1.5V cell across these points. Naturally, our diplomatic technician simply replaced the battery...

The question of ethics needs to be countered by how effective the 'fix' is, and how much it would have cost to find and repair the real fault. Most people would object to having a battery added to their TV set or a hole cut in the back of their VCR, simply because they know it's not part of the original design. But if the appliance is over 10 years old, and a hole in its rear fixes it, why not do it?

I do think that in this case your remedy might be temporary, as temperature sensitive faults usually get worse until the component fails altogether. But you might get another 12 months or more of operation. Thanks for relating this tale, Ron.

## Repair paradox

The next story also relates to the Serviceman column. However, the writer has not quite solved his problem...

*Our TV set previously developed a Teletext retrace fault, with white lines being a nuisance for over 14 months. However, thanks to The Serviceman, in particular to T.B. of Tasmania (June '94), the fault was described. Simple — change C512.*

*But three days before I decided to replace this capacitor, the set stopped working altogether. I decided to replace C512 anyway, which I found lurking in the folds of a heatsink. That done, now to get the set going.*

*I found that when I touched the case of a likely looking power supply transistor, type STR450, with the probe of my analog multimeter, the set burst into life. As well, the Teletext lines were gone (thanks, T.B.). However, when the set was switched off, it would only come to life if the STR450 case was touched with a meter probe, assuming the other meter probe was connected to the chassis.*

*I have resoldered all joints around the STR450, but now find that the voltage on the collector(?) of the device cycles every few seconds from 280V to 180V, accompanied by severe picture shrinkage. Without a circuit diagram, diagnosis is impossible. Replace the STR450? After several frustrating attempts to unsolder this device, I found it had three pins, including a three-hole TO3 insulating washer. What is this device? Where do I get a cheap replacement or equivalent?*

*Paradoxically, we would prefer to watch TV with the Teletext retrace lines rather than no picture at all. We await future editions of EA, as maybe another contributor, T.B. perhaps, can solve the STR450 mystery.* (Robert Gott, Indooroopilly, Qld.)

Unless you work in the repair industry, it's almost impossible to keep up with components. You can purchase an STR450 from WES Components (Locked Bag 30, Ashfield 2131, phone (02) 797 9866) for around $17.00. I can't find any data on the device, but the three-pin configuration is consistent with a voltage regulator of some type.

The fact that a current path to earth starts the circuit is also typical of a regulated power supply fault. However, it also suggests a component external to the regulator (if that's what the STR450 is).

But without a circuit diagram, it won't be easy to find, so perhaps a circuit of the set is the first thing to get. Good luck!

## Cleaning fluids

The next letter is one I've had on file for a while, waiting an opportunity to use it. As we're on a servicing and repair kick, I thought it appropriate to include it now. The writer has quite a few hints about cleaning electronic componentry. But first he has a few things to say to Tom Moffat.

*Shame! Shame! Shame! to Tom Moffat for suggesting we use the dreaded fluorocarbons for cleaning computers (EA, January , 1994). When I was with Telecom, we used to use buckets of Freon, which, as far as I know is no longer available. So Tom had better guard his old can, (along with his monocle).*

*A suitable substitute is CO contact cleaner made by CRC. It is also sold in smaller cans as Video Cleaner. It's safe on heads and connectors as well as plastic and rubber bits. Like Freon, it causes condensation, so make sure you let everything dry before powering up. A hairdryer used sparingly can help.*

*To clean circuit boards, I recommend Electronic Circuit Board Cleaner, made by RF. The brown glue used on PCBs to hold components in place can become electrically leaky with age. When sprayed with this cleaner, it will scrape off easily. After cleaning, spray the PCB with Circuit Board Lacquer, but make sure this doesn't get near connectors.*

*Another good way to protect circuit boards and to clean edge connectors, connecting pins and the like, is to spray a little CRC-2-26 (the oily stuff) onto a rag, and to carefully wipe it over the board and connecting pins before plugging the PCB into the circuit. This spray is also good for fixing dirty switches, wet ignition systems, dirty potentiometers and so on. Just keep it well away from rubber belts, idlers and other friction drive components. I use a small paint brush to apply it to bearings, cams and sliders.*

*However, I'm referring to proper electrically approved spray, not the cheaper imitations available for $2 a can. Keep these for wet lawn mowers, as the solvent in these is about as good as kerosene. Incidentally, these WD (water displacement) sprays were invented by the US army as a quick fix for their field vehicles. Surely one of the great inventions of the 20th century!*

*Another spray, called Contact Cleaner/Lubricant is a CO cleaner, but with contact oil added. When the solvent evaporates, it leaves a slightly greasy lubricant, which is good for connectors and contacts that are under a reasonably high pressure, such as in rotary TV tuners. It is also good on potentiometers, but don't use it to lubricate fine metal or plastic mechanisms, as the lubricant becomes too thick as it dries.*

*Finally, CRC make a silicone spray that is excellent for lubricating plastic-on-plastic or plastic-on-metal surfaces.* (Chris Nelson, Morphett Vale, SA.)

Thanks for this information, Chris. I note from your letterhead that you are a practicing technician, and no doubt these hints are the result of many years' experience. The only criticism I have is the use of oily contact cleaners on potentiometers and switches.

I was always taught that because oil will allow dust and dirt to build up into a coagulated mess, it should be avoided if a surface is to remain clean. Of course, the wiping action of the switch or pot will probably move the muck away from the point of contact, but I still avoid using an oily spray on these components.

## Removing PCB components

The next letter describes a trick that I'm not sure I want to try. Still, it might save quite a bit of time for those who do:

*It's possible to pick up printed circuit boards loaded with components for a dollar or so at the Sunday markets. But how to get the components off? A trick is to wait until Mum goes out, then put enough oil in the bottom of a frypan so it wets the bottom of the board. Heat the frypan, then while holding the board down with a screwdriver, use grabbers of some sort to pull the ICs out. The process makes quite a smell, so be sure Mum's out long enough to air the kitchen.*

*On another subject, I'm interested in stepper motors, as I have recently picked up quite a few from the markets for 50c each. Are you thinking of describing a drive unit for stepper motors that doesn't require a computer?* (Noel Smith, Springvale, Vic.)

Thanks for the oil idea, Noel. While I've no doubt it works, it seems rather hard on the ICs, unless you can do the extractions reasonably quickly.

Regarding stepper motors, you'll find exactly what you want in the November 1994 edition of the magazine. In the Experimenting with Electronics

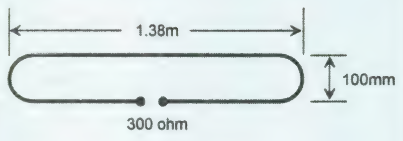


Fig.1

section, I describe two stepper motor driver circuits, one that requires a computer and another based on a stepper motor driver IC. Part one of the article (in October '94) describes how stepper motors work.

## Battery charger

Last October several readers prompted a discussion on car battery chargers, including a few updates for the venerable *EA* October 1971 battery charger. It seems this charger has quite a few friends, including our next correspondent who has a minor grumble about its performance, and a modification to fix it.

*I read with interest your comments in Information Centre, relating to battery chargers. I support the view that the 1971 charger is excellent, and it is still my battery charger of choice.*

*However, I was using it to keep batteries in a boat topped up. Because the trickle charge current was too high, the battery used electrolyte and would be damaged if the charger was left connected for too long. I then modified the charger by adding an op-amp with hysteresis so the charger turned off completely.*

*This means that the charger generally turns on once or twice a day for a very short time. On this basis the charger can now be left connected to the battery for months on end, with the battery always completely ready to go. I suggest that you incorporate such a feature into any new charger.* (Robert Armstrong, Toronto, NSW.)

The problem of overcharging a battery through excessive trickle charging has not always been addressed in battery charger designs, Robert. However you might also have read in the October edition that we were planning a battery charging regulator for use with a solar panel or external DC supply. This charger incorporates the switch you mention and completely stops the charge current to prevent overcharging.

## Folded dipole

For all sorts of reasons, the folded dipole is a popular choice as the active element in a TV or FM receiving antenna. Our next correspondent wants some information about this ubiquitous element.

*I am building a Yagi antenna array and I want to know the optimum overall length of a folded dipole specifically for FM102.1. I have arrived at a value from an equation I've found, but does the length vary with the spacing and tube diameter?* (George Smith, Tuncurry, NSW.)

The length of a folded dipole is generally a half-wavelength of the signal being received. It is found with the equation velocity/frequency, where velocity is the speed of light and frequency is that of the received signal. Velocity is 299,792,458 metres per second, which is about 300 x $10^6$ m/s. So, for a frequency of 102.1MHz I calculate a dipole length of 1.47 metres. To allow for end effects, it's usual to reduce the length of a dipole by around 5%, giving about 1.38 metres.

The spacing between conductors in the dipole is not critical providing it is small compared to its length. For a 1.38 metre dipole, I'd suggest 100mm spacing or less, as in Fig.1.

The diameter of the tubing can have an effect on the impedance of a dipole, but not really on its tuned frequency. According to Grob's *Basic Television*, the impedance of a folded dipole equals *72 ohms multiplied by the square of the ratio of the total diameter of all conductor sections, to the diameter of the open section (i.e., the section with the gap in the centre).*

So, if the diameter of all sections is the same, the total diameter is twice the diameter of the open section, and the antenna impedance is 4 x 72, or 288 ohms, close enough to 300 ohms. If the diameter of the closed section is doubled compared to the diameter of the closed section, the impedance of the antenna equals 9 x 72, or 648 ohms.

In your case George, I assume you're simply bending a length of aluminium tube, so section diameters won't be a factor.

## DC generator polarity

In September 1994 I included a story from a reader under the heading 'Spanner in the works'. The story, set in wartime France, described how the writer used a generator as a motor to start the Renault engine supposed to drive the generator.

According to the writer, part of the difficulty was the problem caused by the residual magnetism in the generator changing polarity, meaning the output leads of the generator had to be reversed once the Renault fired up. But our next letter casts doubt on the validity of this story:

*The story about the antics of the Renault gen set is a good one, but it would be even better if it was correct!*

*A DC generator doesn't reverse polarity if it's used as a motor, so long as the power source is not reversed at the same time. When power is applied to it, it will rotate in a direction dictated by the connections of the field to the armature. Its eventual speed will be controlled (limited) by the load, and its mechanical and electrical efficiency. But its polarity does not reverse.*

*I have had considerable experience with DC motors and generators. Many 32V home lighting plants were started in the manner described, and the North East starter/generator, as fitted to Dodge cars in the late 1920's, was similar in its configuration when used in the start mode. Lucas, in the UK, used a similar system.*

*I have occasionally connected the positive lead of a Windlight generator to the positive terminal of the battery, to save climbing the tower to clear a stuck brake.*

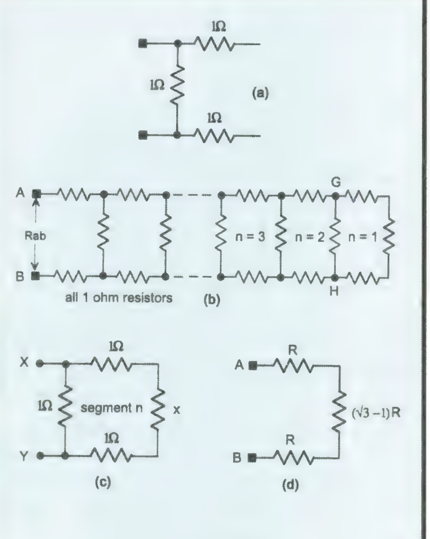


Fig.2

*But who knows? A French generator, French electricity. Vive la difference!* (R. Gebhardt, Mount Bryan, SA.)

Thanks for your comments Mr Gebhardt, but I suspect you are both right. I agree that for the same voltage polarity, a motor runs in the same direction as that required by the motor when running as a generator. This is the principle of dynamic braking used on electric trains.

It's also easily confirmed by connecting a permanent magnet motor to a voltmeter and noting the polarity of the voltage for a particular direction of rotation. When the motor is connected to a supply of this polarity, it will run in the same direction.

But I somehow doubt that our contributor got this wrong, as it's a significant part of the story. There's probably something about the Renault gen set we don't know that caused the polarity reversal. Still, it's good to get the facts straight.

## 68705 development system

*I read with interest your article entitled Low Cost PC-based 68705 Development System (EA, March 1993). However, when I contacted Oatley Electronics about purchasing a kit, they indicated they were no longer the distributors. Can you advise me where this kit can be purchased, and whether there have been any updates?* (M. Grover, Raymond Terrace, NSW.)

Since publishing this article, there have been quite a few changes. First, to purchase kits contact OzTechnics, PO Box 38, Illawong 2234, phone (02) 541 0310, or fax (02) 541 0734.

A substantial update has since been made, and details can be found in *EA* July 1994, page 114 in my review of the updated software and hardware. As well, although not yet published, a very low cost and small size development system for the Motorola 68705 K microcontrollers has been finalised. Details will be presented shortly.

## October's What??

I said last month I'd try and publish a range of solutions for the October '94 What?? question. The answer to this question was given without proof, with the invitation for readers to send in a solution. The second of these is from John Denholm, of Warncoort, Victoria, and refers to the diagrams in Fig.2.

For convenience, let R = 1 ohm. Apart from the two resistors connected to A and B, the network consists of a large number of identical segments as in Fig.2(a).

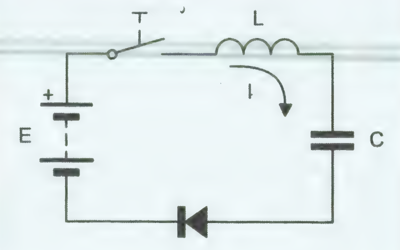


Fig.3

The right hand segment of the network is terminated by a one ohm resistor (although the value of this resistor makes no difference to the end result). The segments are numbered from right to left as shown in Fig.2(b).

Now calculate the equivalent resistance of segment 1, between points G and H, using the equation for two resistors in parallel: $x = (R1R2)/(R1+R2)$. This value terminates segment n=2 as in Fig.2(c). This process is repeated until all segments are reduced to a single resistance value.

In Fig 2(c), the resistance between points X and Y is $R = (2+x)/(3+x)$, where x is the equivalent resistance of all segments to the right of the nth segment. Reducing the network to a single resistance involves an iterative procedure. Having calculated r, we then plug this value back into the same formula in place of x to calculate the value for r for the (n+1)th segment, and so on. Thus for n=1, with x=1: $r = (2+1)/(3+1) = 3/4$.

For n=2, $r = (2 + 3/4)/(3 + 3/4) = 11/15$ etc. (Doing this on a calculator shows a rapid convergence to a value of r = 0.7320508, which looks suspiciously like $\sqrt{3}$ minus one.)

Now, convergence to a certain fixed value of r means that for a large enough number of segments, further iteration leaves r unchanged. That is, r = x, so $(2+x)/(3+x) = x$. This equation is rearranged to give $X^2 + 2x - 2 = 0$, which is easily solved to give a positive solution of $x = \sqrt{3} - 1$. Hence the network reduces to that in Fig.2(d), with the original R replaced, to give $Req = R(1 + \sqrt{3})$.

Table 1

| No.1 | No.2 | No.3 | Product | Sum/2 |
|---|---|---|---|---|
| 7 | 14 | 25 | 2,450 | 23 |
| 7 | 10 | 35 | 2,450 | 26 |
| 5 | 14 | 35 | 2,450 | 27 |
| 5 | 10 | 49 | 2,450 | 32 |
| 7 | 7 | 50 | 2,450 | 32 |
| 2 | 25 | 49 | 2,450 | 38 |
| 5 | 7 | 70 | 2,450 | 41 |
| 1 | 49 | 50 | 2,450 | 50 |
| 5 | 5 | 98 | 2,450 | 54 |
| 1 | 25 | 98 | 2,450 | 62 |
| 2 | 7 | 175 | 2,450 | 92 |
| 1 | 14 | 175 | 2,450 | 95 |
| 2 | 5 | 245 | 2,450 | 126 |
| 1 | 10 | 245 | 2,450 | 128 |
| 1 | 7 | 350 | 2,450 | 179 |
| 1 | 5 | 490 | 2,450 | 248 |
| 1 | 2 | 1,225 | 2,450 | 614 |
| 1 | 1 | 2,450 | 2,450 | 1,226 |

## What??

This month's question is from Ron Steinfeld, of Glen Waverley in Victoria. Ron has contributed What?? questions before, and this time he writes:

A capacitor with capacitance C, an inductor with inductance L, a diode and a switch are connected in series across a DC voltage source of E volts, as in Fig.3.

Initially the switch is open and the capacitor fully discharged. The switch is then closed and after a short time, the circuit current stabilises to zero. Assuming ideal components (the diode is a short-circuit in the forward direction and an open-circuit in the reverse direction), what is the DC voltage across the capacitor after the circuit stabilises?

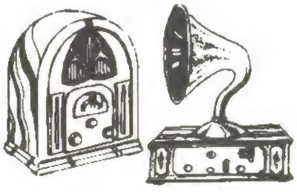
## Answer to December's What??

First determine the factors of 2450, which are 1, 2, 5, 5, 7 and 7. Then work out every possible combination of these factors in three numbers, and half their sum. These values are shown in Table 1, in ascending order for sum/2.

When the serviceman determined the value of the input resistor, he should have been able to choose the set of values which gave that value as half their sum. But he couldn't, because a value of 32 ohms for the input resistor has two possible results: 5, 10, 49 or 7, 7, 50.

When he looked at the value of the bias resistor, it resolved this dilemma. If the bias resistor was more than 50 ohms, it would not resolve the problem. If it was 49 ohms or less, it also would not resolve the problem. Therefore, the answer is 50 ohms. ❖

# Vintage Radio



**by PETER LANKSHEAR**

## How Astor radios were made

One of the aspects that make vintage radio such an interesting subject are the extreme changes in technology that have taken place in the last half century. Few valve receivers contained more than 10 valves — which, together with their attendant components, were painstakingly hand assembled into massive steel chasses. Today, integrated circuits smaller than most individual valves can contain many thousands of transistors, and entire printed circuit boards are machine assembled in the time that it could take to install a single component in a valve radio.

Recently, we described a receiver made by New Zealand's Radio Corporation, but there were Australian Radio Corporation receivers too, sold as the well known and respected 'Astor' brand. In 1922, before broadcasting in Australia ever started, Melbourne's Louis Coen Wireless was selling radio components to enthusiasts. Then, in 1926, a group of three small manufacturers combined forces to form The Radio Corporation of Australia, making Astor radios to be distributed by the Coen organisation. Before long, Coens joined forces with the Radio Corporation, which went on to become one of Australia's largest radio manufacturers.

We may have their radios today, but what do we know of how they were made, and under what conditions? Fortunately, Douglas Bolton of Mount Waverley in Melbourne has taken time off to write down his experiences in the Astor factory. Here, in his own words is his story:

*In July 1946, on the day the US detonated the world's first H-Bomb on a Pacific atoll, I started work on the wiring line at Radio Corporation in Grant Street, South Melbourne, assembling Astor radios. At first I sat alongside an older hand, Geoff Austin, at his station to learn the ropes. That meant, basically, learning the 'Astor Way' of laying out wiring, placement of components and making terminations to the company standard.*

**Astor were noted for their innovative cabinet design. The tuning and volume labels shown on this attractive 'KK' model are, of course, only on the photograph.**

*There were two lines running parallel to each other, usually working on the same model run, although there may have been exceptions to that. Each line was a long bench about 600mm wide and of normal workbench height, topped with sheet iron.*

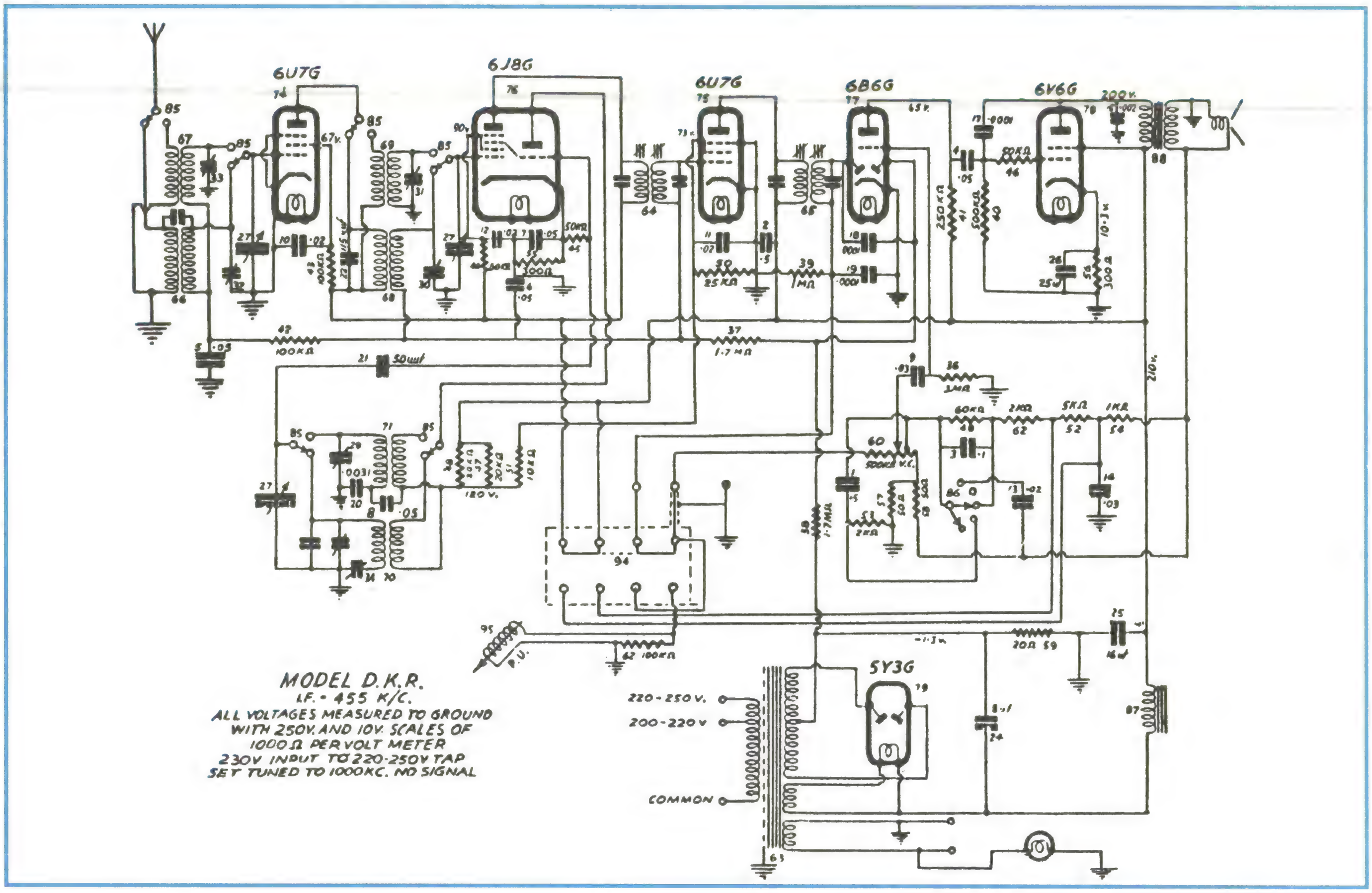
*Attached to each side of each line at about one-metre intervals were the wiring stations, with the stations on one side staggered with respect to those on the other side, so that the sets zigzagged along the line.*

*Each station was a small bench about 600 x 900mm, and attached to its back was a frame carrying a placard setting out the details of that operator's task(s) for that particular model run. There would be a sketch of the chassis and the parts and/or wiring to be fitted, as well as written instructions.*

*You did not have to be able to read a circuit; some of the wirers were complete laymen in radio terms. To them it was a job, nothing more. Nevertheless the wages incorporated a skill margin above the basic wage as it then was.*

### Hot irons

*Running under each line was a pair of heavy gauge conductors carrying about 30 volts, wired to a pair of terminals on the front of each station to power the soldering irons. The irons were specially made for the voltage, obviously to discourage the temporary or permanent 'borrowing' of irons for use at home! Those irons were HOT. It was possible to light a cigarette off the side of the bits, which were large by today's standards — 3/16" or 1/4" in diameter,*


6U7G
6J8G
6U7G
6B6G
6V6G
5Y3G
MODEL D.K.R.
I.F. - 455 K/C.
ALL VOLTAGES MEASURED TO GROUND
WITH 250V. AND 10V. SCALES OF
1000Ω PER VOLT METER
230V INPUT TO 220-250V TAP
SET TUNED TO 1000KC. NO SIGNAL
P.U.
220-250V.
200-220V
COMMON

**It is clear from this 1940's radiogram circuit that Astor produced well engineered, conservative designs. An advanced feature, as mentioned by Douglas Bolton in his comments about enhanced reproduction, is the elaborate negative feedback network, connected to the tapped volume control, and providing a degree of bass and treble accentuation. Resistor 52 (5k) is shorted out in the gramophone position to produce still more bass boost for pickup equalisation.**

*if I remember rightly. After all we are talking about octal valve sockets here, and a one watt resistor in those days resembled a small cigarette.*

*The iron line was fed from what must have been a monstrous transformer, in its own enclosure off to the side of the line. The bits were unplated copper, so the rate of wear and corrosion was high. At one end of the line was a power grinding wheel, where you could 'freshen up' a worn bit. Skilled engineering types are horrified at the very idea of fouling up a grinding wheel with lumps of solder, but the wheel was there just for that purpose, so who am I to complain?*

*Roughly every fourth or fifth station was manned by a wiring inspector, whose job was to check the accuracy and quality of all work up to that point. Soldered joints were tested by trying to break them loose, with a screwdriver used as a crowbar under the leads to the joint. The inspectors generally were a fair minded crew, who could pick the difference between a botched operation and a production engineering miscalculation.*

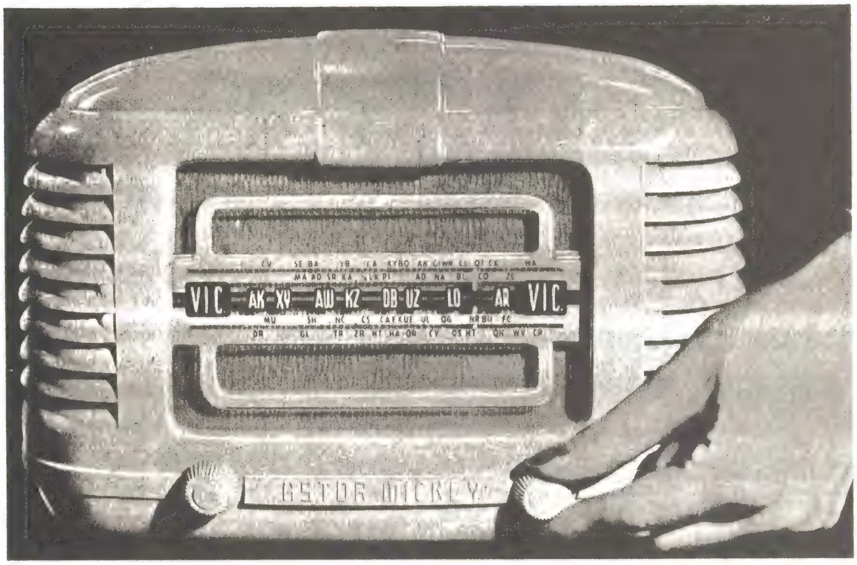
*My impression was that quality control was very good. I would think that very few sets, if any, would have reached the end of the line containing wiring faults. All terminations had to be 'mechanical joints'; that is, the pigtail or wire was passed through the hole in the valve socket or tagstrip lug, bent over and fed through again, and then squeezed firm with long-nose pliers. This was because the operator making the joint was not necessarily the one who soldered it, and the joint had to remain sound until the final soldering. I heard that servicemen hated having to replace any parts so fitted, and I can understand why!*

*Placement and orientation of parts and wiring was strictly laid down on the layout placards. If the diagram showed a wire passing to the left of a tagstrip, for example, one didn't dare run it to the right! Resistors and capacitors were laid as close as practicable to the chassis and always parallel to one of the axes of the chassis. Non-signal wires, likewise, ran in neat straight lines parallel to the axes, with right angle bends where necessary.*

*Anode and grid leads, of course, ran as directly as possible at whatever angle was necessary. RF and IF signal leads were in stranded hookup wire, mains in standard power flex, AF in old style shielded hookup, with everything else in rubber covered single strand tinned copper of about 22SWG.*

*One feature which puzzled me then, and still does, was that the heater wiring in mains sets was not twisted as 'good practice' dictates. At the power transformer, one 6.3 volt lead was grounded, as was one heater lug at each valve socket. The hot filament lead snaked around the chassis to the remaining heater lugs. How come those sets were never known as 'hummers'?*

*The chassis arrived at the start of the line ready-to-wire, as it were. Valve sockets, and any speaker sockets and battery connectors, were pre fitted. The first operation was to fit a pair of purpose-made metal cheeks to the chassis ends. These served both as handles and as protection for high profile components like tuning capacitors and power transformers, as the chasses made their not-always-cushioned* *progress down the line. Those high profile parts were usually the first components, as such, to be fitted.*



**Promotional material from Astor, advertising one of their well known Mickey (Mouse) series of radios in compact plastic cabinets. This particular 'KM' model was clearly intended for use in the home state of Victoria.**

## Few nuts and bolts

*Nuts and bolts were kept to a minimum. Much use was made of self-tapping screws, usually hexagon headed, and driven home by Spintites.* (Ed: otherwise known as 'nut drivers'.) *Valve sockets and the like were eyeletted to the chassis before reaching the line, and earthing points were preformed 'lugs', made by pressing tongues of the chassis metal down into the underside of the chassis during the actual chassis fabrication.*

*Tagstrips ('distrips' in Astor-talk) were soldered to the chassis by their mounting feet. The chasses themselves were steel, plated with zinc, lead or cadmium — I am not sure which, after all this time.* (Probably cadmium — P.M.L.) *Certainly the latter two would be rather naughty today. Whatever it was, it made soldering to the chassis very easy.*

*Radio Corporation was fairly self-sufficient as to components. They bought in Philips or Radiotron valves (always American type numbers in my time), Rola speakers (without transformers), Ducon fixed capacitors, IRC fixed resistors, nuts, bolts and screws, dial lamps and cord, wire, Ersin solder, dry batteries and record player decks. They made their own chassis, cabinets (both timber and plastic) knobs, dials and associated hardware, tuning capacitors, potentiometers, all inductive components, valve sockets, dry battery connectors, tagstrips, rotary mains switches, wafer switches and Ferrocart car radio vibrators.*

*Although, as I said, the company made its own inductive components, there was a temporary exception in the case of IF transformers. One day the lines came to a dead stop for lack of IF's. It turned out that the IF making facility had broken down, and there was much rushing about by foremen and higher ranks until production eventually resumed, using a supply of IF's which had been hastily arranged from the nearby Kingsley factory.*

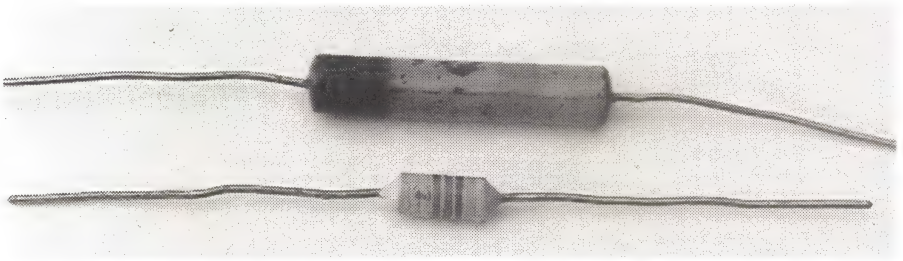
*Somewhere out there could there be a restorer scratching his head over an Astor containing 'foreign' IF's. Fear not, it could be authentic!*

*The atmosphere on the line among the wirers was friendly and cheerful, on the whole. They were not a bad bunch of people and included a sprinkling of female wirers, who wielded soldering irons and pliers on an equal footing with the males — but not on an equal wage footing, in those unenlightened times.*

*Not once did I personally see any sexual harassment; not that there was much spare time for any of that. Although there was a good fellowship on the line itself, management was not universally admired, but I suppose that is par for the course in factories. The obvious and immediate targets for this lack of affection were the foremen (one per line) who, to give them their due, had a less than easy ride in those days of full employment and the postwar labour shortage. They looked to me as men under considerable pressure. Although I never liked them as people, and that could be my fault as much as theirs, I have to admit to feeling some sympathy for them.*

*Radio Corporation had its pilfering problems, just like any factory making consumables I suppose. At the time of which I write, there were shortages of tuning capacitors, electrolytic capacitors and speakers, at least at the retail store level. Presumably, as the radio factories were absorbing all available supplies to meet the postwar demand for new sets, any temptation to 'lift' such things from the factory was heightened. There was a legend that even twelve inch speakers had been smuggled out!*

*Anyway, the management occasionally conducted random searches of bags and pockets, by the time clocks at knock-off time. I saw it happen once or twice, but I never was one of the 'chosen'; the checkers just picked out individuals at random.*



**Comment was made about the cigarette-sized one watt, IRC resistors that were used in immediate post ware radios. For comparison, one is shown alongside a modern equivalent. Not only is the modern resistor much smaller, but it is also more reliable.**

## Good quality sound

*As finished sets left the line, they went to the final test to be fitted with valves and then to a screened room for alignment. My impression at the time was that they were rather better than the average domestic radio, in terms of both RF sensitivity and sound quality. As regards the latter, of course they* *were not hi-fi, but they had a rich full sound without being mellow or boomy, and this was true of the smallest mantel as well as the table models and consoles. I think that this was due to a form of automatic loudness control in the audio end. They had, for the time, a fairly sophisticated frequency-dependent feedback loop around the output transformer, in conjunction with a tapped volume control.*

*Four years after I left the company I bought my first car, which came with an Astor radio as standard equipment. The sensitivity of the set was quite remarkable, but the nature of the sound it produced from a Rola 5C speaker was almost unbelievable. The subjective impression was that the speaker had to be an eight inch at least.*

*To summarise my time at Radio Corporation, I have to say that I did not greatly enjoy it, but it had its moments. It was an interesting and valuable experience which laid the foundation for my subsequent working life in radio and electronics. The following eleven years I spent on the communications side of radio in the Department of Civil Aviation, and I was struck by the number of colleagues who had passed through the nursery of 'The Corp.'*

Well, thank you Douglas. I found the story quite fascinating, and I am sure that many readers will have too. Recording of experiences like this are very important. It is easy enough to find old balance sheets and annual reports to provide a financial history of an organisation, but without the participants making the effort to write them down, the real stories about people and conditions become lost.

One can understand a certain lack of enchantment with repetitiously fitting the same section of wiring and components, day after day. Those of us who never experienced the 'joys' of working in a radio factory half a century ago, may now have a better appreciation of what went into making today's 'collectibles'.

In *EA*'s predecessor *Wireless Weekly* for February 15, 1938, there is an article on the Astor factory with a photograph, unfortunately not suitable for reproduction, showing a wiring line just as Douglas describes them. What he does not spell out is that workers had little elbow room, and such luxuries as a view through a window were completely absent. I suspect that these workers would have had some sympathy for battery hens!

Douglas comments about the freedom from hum in receivers which did not have twisted and balanced filament wiring. When mains powered equipment first appeared, considerable attention was paid to wiring the filament circuits with twisted leads, and this practice continued with professional equipment such as Douglas would have encountered in Civil Aviation.

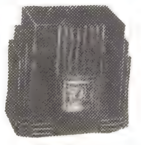
However from around 1932, especially with the introduction of the lower-current 6.3 volt heaters, receiver manufacturers found that filament lines did not radiate much hum and that time could be saved in assembly by running a single lead, with the other side of the filaments grounded.

One situation arose, however, that should be remembered in repair work. Filament currents in the chassis can generate significant differences in potential between two earthing points, and one of the tricks of good design was to select the best points to make audio circuit earth connections. The wrong position can cause a significant increase in hum.

After his explanation as to why 'belt and braces' techniques were used in terminating component leads before soldering, I shall in future try to be a little more tolerant when attempting to unblock holes in solder tags! A countless number of solder tags must have been broken over the years as a result of this practice, although some manufacturers, (AWA was one), kept such joints to a minimum.

Finally, my thanks again to Douglas Bolton for his memoirs, and also to Darryl Kasch for providing the circuit and receiver illustrations. ❖

RESURRECTION RADIO



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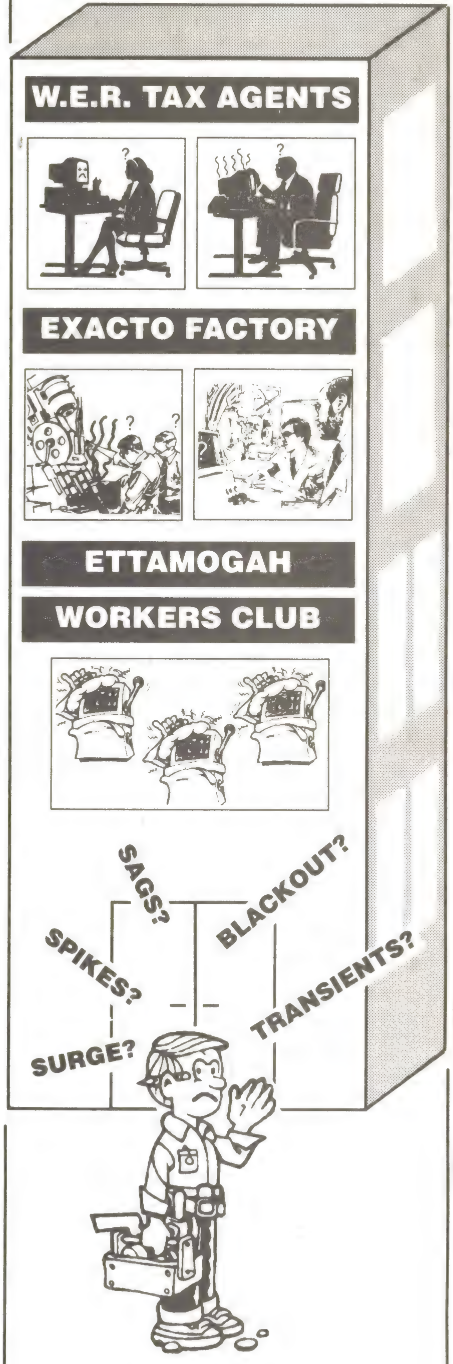
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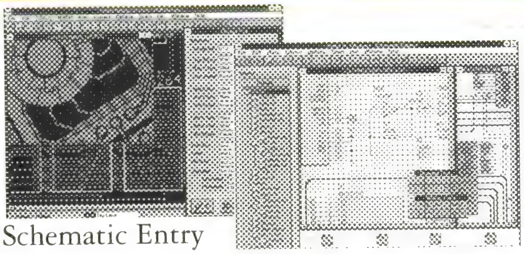

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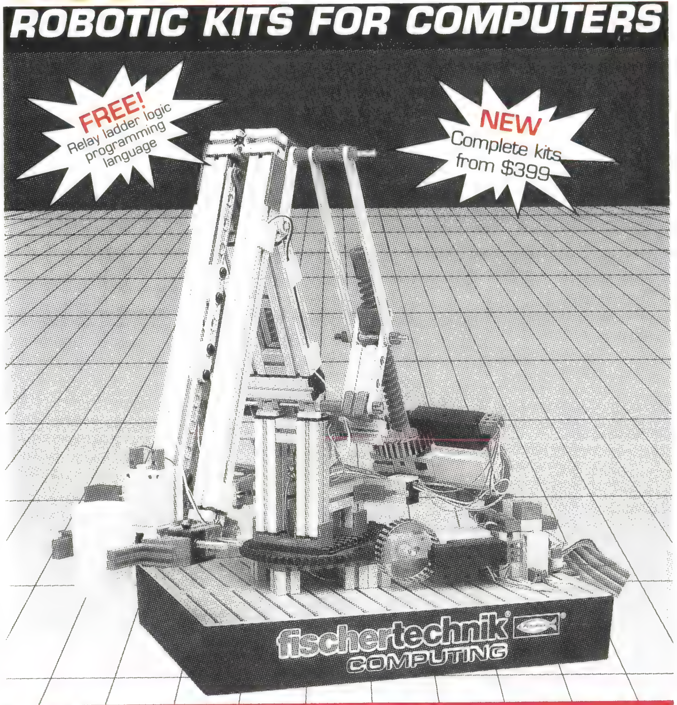
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L.L. BROWN ADVERTISING 4917

# Four Sound Siren Generator

*Continued from page 69*

When the yelp button is pressed C3 is discharged and en slowly charges up again, giving a single high-to-low requency sweep — which is the yelp sound.

For the 'whoop' sound, links J1/J2/J3 are all placed in he 0-3 position. The whoop sound is similar to the wail, ut with the high to low frequency sweep removed.

The repetition rate is faster than for the wail, because R4 as been shorted. When the output of IC1 is high, C3 charges apidly via R7 and D1 — resulting in no sound output during his period. When the output of IC1 goes low, C3 discharges lowly via R6, causing the output to sweep from a low to igh frequency, and thus making the desired whoop sound.

Finally for the 'hee-haw' sound, links J1/J2/J3 are all laced in the 0-4 position. The repetition rate is now faster than for either the wail or whoop sounds, because J1 now shorts out both R3 and R4. The square wave output of IC1 now produces a square wave control voltage, and this is coupled straight to pin 5 of IC2 via J2, resistor R5 and J3. This causes the sound output to simply alternate between two frequencies, rather than sweeping back and forth over a range of frequencies.

As you can see, there are plenty of opportunities for you to experiment with component values, to see what further effects you can achieve. For example you can try varying the values of C1 and/or R2, to change the sweeping rate; or try varying the values of R5, R6, R7, R8 and C3, to achieve different sweeping effects; or finally, try varying C4 and/or R9 to adjust the output frequency.

For such a simple circuit, it's surprisingly flexible. ❖

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Volume 2

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# MARKETPLACE

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**Motorola 6805 Emulator:**
and 68705 micro programmers. Prices and data from Graham Blowes, Mantis Micro Products, 38 Garnet St, Niddrie, 3042 Phone (03) 337 1917 (A/H); ph (03)575 3349 (B/H); fax (03) 575 3369.

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**Copy Handbook** of Filter Synthesis. Zverev, Wiley, 1970. Phone (02) 631 3490.

**Made in the USA** or western Europe for Audio valves, Vintage equipment and books about Valve Technology. Wai Kei Leung, Block B, 5th Floor, 7 Kweilin Street, Shamshuipo, Kowloon, Hong Kong; Fax: 852-387 5560.

**Handbook/Data** for visual alignment SIG/GEN made by Ratcliffe Eastwood / NSW (DCA Ident Y10/35) (Model 203). Phone (054) 41 1197. Also, valves available - see my ad in Aug/Oct Marketplace.

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# 50 and 25 years ago...

*'Electronics Australia' is one of the longest running technical publications in the world. We started as 'Wireless Weekly' in August 1922 and became 'Radio and Hobbies in Australia' in April 1939. The title was changed to 'Radio, Television and Hobbies' in February 1955 and finally, to 'Electronics Australia' in April 1965. Below we feature some items from past issues.*

## January 1945

**Photo through steel:** Dr Ernest E. Charlton, of General Electric Co's research laboratory staff, announced at the national electronics conference the perfection of a two million volt mobile X-ray machine, capable of taking pictures through one foot of steel.

The machine doubles the available voltage for examining metal sections to find defects. The 5000lb apparatus is able to radiograph eight inch steel castings in three and a half minutes, or 77 times as fast as a one million volt unit.

**Hollywood and the decibel:** The decibel has come into its own in Hollywood. A decibel specialist was recently appointed by a film company to study the decibel count of food.

It appears that the eating of some foods, such as celery and toast, produces quite a bit of noise during the filming of a food sequence. It has thus become necessary to make a study of all the foods that produce noise problems, and substitute 'noiseless' foods.

During the filming of a picture entitled 'Mr Winkle Goes to War' 300 soldiers had to eat 'noiseless lamb chops' because the stars of the picture, Edward G. Robinson and Robert Armstrong had to talk during this sequence. The poor soldiers had to eat 'chops' made of mashed potatoes coloured with gravy, all because of dB.

## January 1970

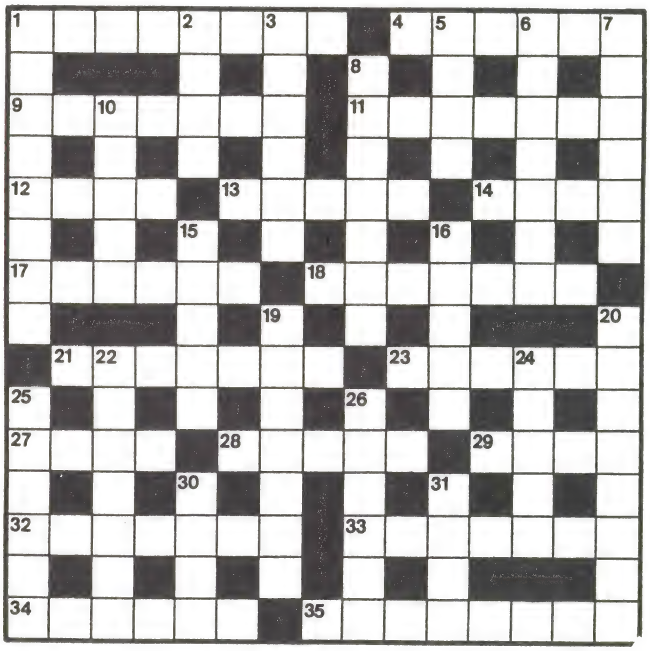
**Seismic exploration vessel:** The first all-Australian seismic exploration vessel, the MV Western Endeavour, was launched at Maryborough, Qld, recently. Designed and built
Australia, it is one of the m
modern ocean exploration ships in
world, and is believed to be the first co
mercial vessel specifically designed to
guided by inertial navigation.

**Space shuttle craft:** Two leading
aerospace firms have teamed to stud
reusable chemically fueled vehicle wh
could fly between earth and low ea
orbit. The Boeing Co, Seatt
Washington, and Lockheed Missiles a
Space Co., Sunnyvale, California, ha
announced that they will seek a spa
agency contract to study the space shut
craft. As presently envisioned, t
space shuttle will consist of a lar
vehicle to provide initial boost and
smaller vehicle to continue to orbit a
perform space missions.

Each vehicle, after completing its tas
would fly back to an aircraft like landin

**Plotting Queensland's roads:** Th
Queensland Department of Main Roa
has installed a Gerber 622 drafting sy
tem to operate in conjunction with a ne
$700,000 computer complex. The syste
will enable the Department to speedi
perform a variety of functions such a
graph-plotting contours, road survey
cross sections, and profiles of roads fo
use in construction. ❖

# EA CROSSWORD



### ACROSS

1. Garble a signal. (8)
4. Observational passes. (6)
9. Natural objects in space. (7)
11. Sequence of instructions. (7)
12. Letter of phonetic alphabet. (4)
13. Path of satellite. (5)
14. Given name of philosopher Descartes. (4)
17. Moment. (6)
18. SI units. (7)
21. Spacecraft of the early 70s. (7)
23. Key function on a computer keyboard. (6)
27. Detectable meteorological phenomenon. (4)
28. Popular brand of mobile phone. (5)
29. Send alerting signal. (4)
32. James Chadwick discovered this. (7)
33. Learner in education. (7)
34. Reflected signals. (6)
35. Electronic test instrument. (8)

### DOWN

1. Make a substitute representation. (8)
2. Spacecraft Clementine mapped this. (4)
3. Sources of intense light. (6)
5. Aerobatic manoeuvre. (4)
6. Co-inventor of the transistor. (7)
7. Given name of Morse. (6)
8. Joined tapes. (7)
10. Clock. (7)
15. Section of TV transmission. (5)
16. Once-supposed medium of space. (5)
19. Reversed a tape spool. (7)
20. Signal booster. (8)
22. Particular angle. (7)
24. Removate data from tape. (5)
25. Edge of footprint. (6)
26. Inventor of the cloud chamber. (6)
30. Perfect vacuum, or ---- space. (4)
31. Source of energy. (4)

### SOLUTION FOR DECEMBER 1994

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| G | I | O | T | T | O | | F | E | E | D | B | A | C | K |
| H | | F | | R | | R | | X | | I | | T | | I |
| O | F | F | L | I | N | E | | C | O | M | P | T | O | N |
| S | | P | | P | | V | | I | | S | | R | | E |
| T | R | E | E | | M | E | L | T | S | | W | A | T | T |
| S | | A | | S | | R | | E | | V | | C | | I |
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| T | O | L | L | | B | R | A | U | N | | B | O | N | D |
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| O | | O | | L | | N | | Y | | P | | U | | O |
| T | I | M | E | B | A | S | E | | N | E | W | T | O | N |

Electronics Australia's

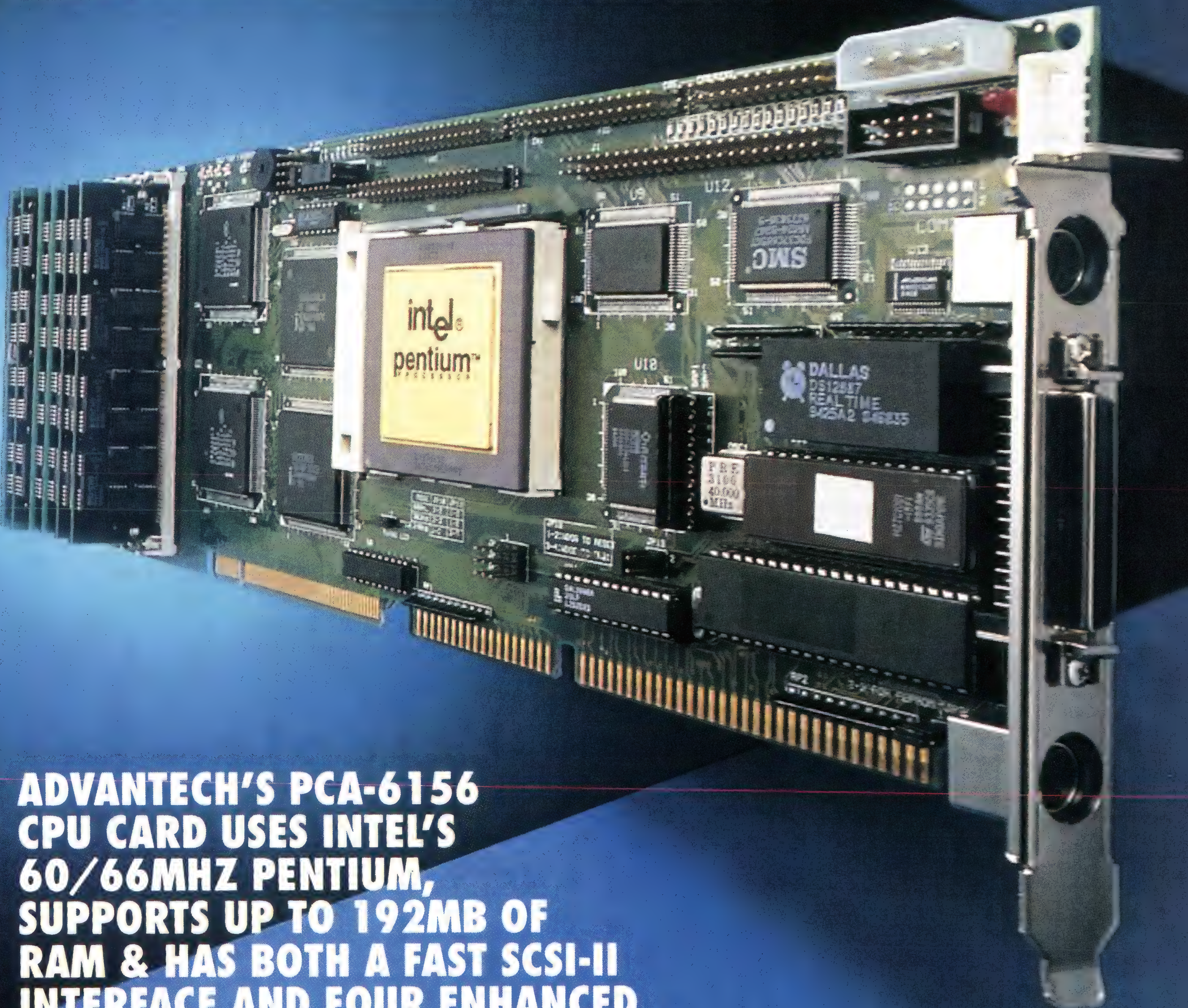
# Professional Electronics

SUPPLEMENT

UNSW'S EXPERIMENTAL SOLAR ENERGY PROJECT FEEDS POWER INTO GRID

REVIEW: HIGH QUALITY TV SIGNAL & PATTERN GENERATOR FROM SPAIN

INTERACTIVE SIMULATOR IS WINDOWS BASED



ADVANTECH'S PCA-6156 CPU CARD USES INTEL'S 60/66MHZ PENTIUM, SUPPORTS UP TO 192MB OF RAM & HAS BOTH A FAST SCSI-II INTERFACE AND FOUR ENHANCED IDE HDD INTERFACES, VIA ITS PCI LOCAL BUS... *(See page 142)*

## NEWS HIGHLIGHTS

Baltimore Hotel in Baltimore, USA, Mr Rob Rohrlach, Managing Director and inventor of Jeeves commented, "Home computing is the fastest growing consumer market today. Adding controlled intelligence to lights and appliances around the home is a natural extension."

## NEWS BRIEFS

- ***Wedgetail Technologies*** has been appointed distributor in Australia for X-Net OY of Finland. X-Net are manufacturers of PC based protocol analyzers.
- ***COMMTEL CHINA '95***, the International Telecommunications Equipment, Technologies, Networks and Services Exhibition for China, will be held from September 8-11 at the China Foreign Trade Centre, Guangzhou. For further information contact Business and Industrial Trade Fairs, Wanchai, Hong Kong, phone (852) 865 2633.
- A three day training course called ***Data Communications Technologies*** will be conducted by Independent Information Technology Training at Sydney, 22-24 May 1995. For more details phone (02) 252 2844.
- ***Protege Solutions*** has moved to new premises. The new address is Suite 14, Level 1, Pacific Highway, Artarmon 2064, phone (02) 906 1773.
- Sean Synnot has been appointed General Manager, Asia Pacific by US company **ComputerLand**.
- A three day training course called ***PC Troubleshooting*** will be conducted by Independent Information Technology Training at Sydney, 1-3 February 1995, Melbourne, 13-15 February 1995 and Brisbane 22-24 Fenruary 1995. For more details phone (02) 252 2844. ❖

### ALTERA DONATIONS TO AUST SCHOOLS

When classes open in 1995 at more than a dozen engineering schools around the country, students will have a chance to use some of the most advanced 'tools' available for designing modern telecommunications, data communications, computer, and industrial products. These students are studying at universities where Silicon Valley's Altera Corporation, in cooperation with Veltek Australia, have donated advanced development software and programmable logic devices used to create exciting new products.

"High technology evolves rapidly and most universities do not have the capital needed to purchase the necessary equipment," stated Tim Colleran, Altera's development tools marketing manager. "If high technology companies expect students to be trained in the latest technologies, then we have a responsibility to provide them with state of the art tools and training. Altera's Higher Education Program is doing just that."

Among the universities in Altera's program are University of Melbourne, University of Newcastle, Curtin University, RMIT, Torrens Valley Institute and University of Queensland. At the University of Newcastle, the program has been fully implemented with a number of other Universities/Institutes well on their way to incorporating advanced EPLD design into their syllabus.

Altera's Higher Education Program represents one of a number of computer industry initiatives from companies like Hewlett-Packard and IBM, who donate modern equipment and products to help train students and prepare them for their careers.

### NETWORK CARDS FROM NATSEMI/NOVELL

National Semiconductor has broken away from its traditional role of chipmaker with the release of a wide range of LAN interfaces. The range not only sets new prices for top quality LAN cards, but includes a complete LAN starter pack designed to bring the benefits of networking to the home and smaller office.

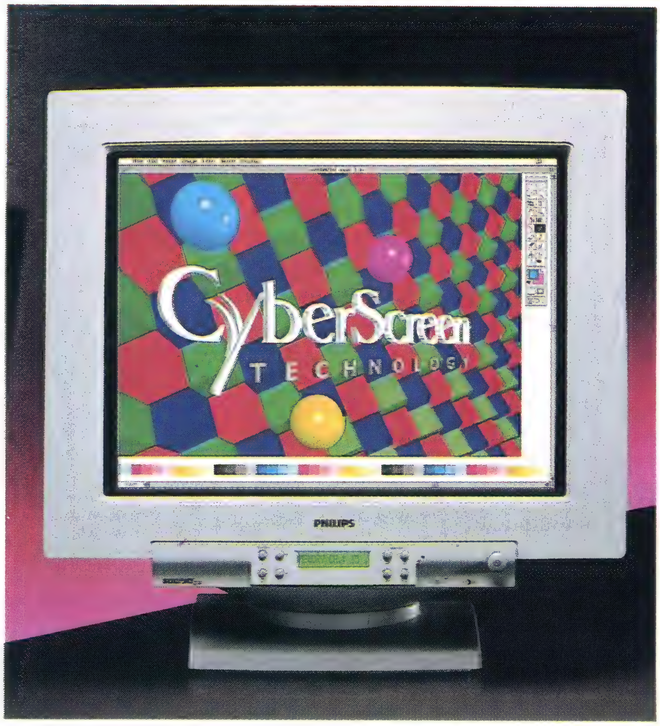
### MONITOR HAS FULL 'DIGITAL ARCHITECTURE'

With its new 'Brilliance 21A' colour monitor, Philips claims it is the first monitor manufacturer to introduce a complete digital architecture which optimises display performance by ensuring that colour, brightness and convergence are maintained within the original specifications across the entire screen area.

Called CyberScreen, the Philips technology package is based on individual microprocessor control of the three video amplifiers for all displayed pixels, according to a comprehensive series of full screen measurements performed in the factory. The microprocessor takes into account the beam colour and the location of the beam in the scanning process, and then carries out adjustments to achieve accurate convergence, uniformity of colour and brightness — for the lifetime of the monitor.

This previously unachievable performance is very sensitive to terrestrial magnetic field variation. But the CyberScreen technology includes electronic compensation for variations in the earth's magnetic field to maintain convergence performance within the specified limits, regardless of changes in location and orientation.

An optical calibration package, comprising a light probe, PC software and connecting cables, enables users to adjust display performance on-site, for fast, convenient and highly accurate setting of colour temperature and for compensation of any drift which may occur during extended periods of operation.



Adjustments are made from the PC keyboard and communicated to the monitor via a built-in RS232 service port.

The new monitors have been developed at the Philips International Centre of Competence in Chungli, Taiwan.

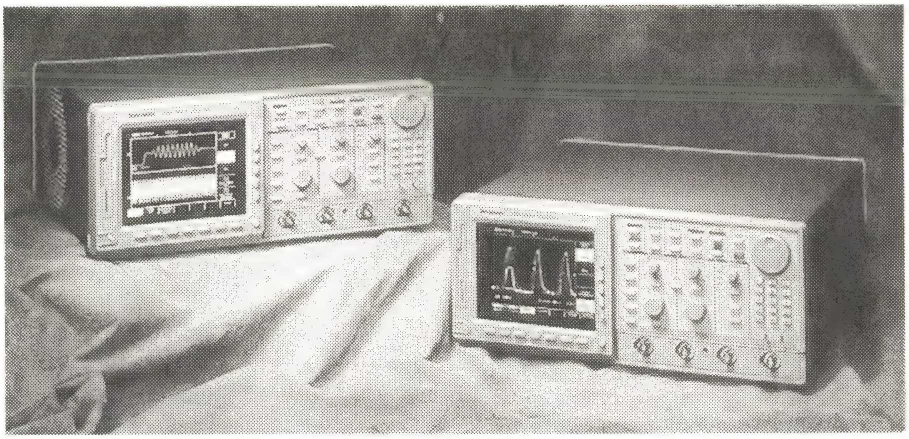
National's Director of Marketing, Mr Geof Karlin, said that while the company is already the major manufacturer of LAN chips, it had made a multi-million dollar decision to become the major supplier of Ethernet cards and systems internationally.

"During recent times National has recognised that it is in the technology business, not just silicon, and we must deliver more complete solutions," Mr Karlin said.

The National range of immediate releases includes Adaptor cards covering both Ethernet and FDDI technologies. National's networking products, which are to be sold under the Infomover label, are co-branded with Novell. "This signifies the co-development of this series with Novell and the industry's highest level of compatibility with NetWare," said Geof Karlin.

National Semiconductor and Novell have chosen Datamatic as the Australian distributor for the new LAN interfaces.

## NEW TEK DSO'S SHOW 2500X SPEED-UP



Elusive errors and intermittent faults can no longer hide behind the waveform capture rates of digitising storage oscilloscopes (DSOs). The new Tektronix TDS700A 'TruCapture' family increases — by three orders of magnitude — the benchmark for DSO data acquisition performance, delivering what is claimed as the world's fastest waveform capture rate of over 400,000 acquisitions per second.

"Tektronix has pioneered a technology breakthrough, ensuring that users will capture a true representation of signal events," says Richie Faubert, Tektronix Instrument Business Unit General Manager. "Measurements from the TDS 700A will give users a higher level of confidence than any other waveform measurement solution in existence today. These instruments are a result of Tektronix' dedication to providing easy-to-use oscilloscope solutions with superior value and performance."

The TruCapture family includes the TDS 784A, with 1GHz bandwidth and 4GS/s maximum sample rate, and the TDS 744A, which operates at real time speeds up to 500MHz, with a maximum sample rate of 2GS/s.

InstaVu acquisition mode, a proprietary Tektronix break through in signal acquisition, allows users of TDS 700A instruments to cut debugging time from hours to seconds. The TDS 700A can acquire and display more than 400,000 acquisitions per second, making it superior to the world's fastest analog real time scopes — the Tektronix 7104 and the 2467B. It is also 2500 times faster than today's state of the art DSOs, which capture only a few hundred real time waveforms per second.

InstaVu acquisition technology combines high speed acquisition memory with high speed hardware rasterisation, to radically increase acquisition performance. With more than 12,000 500-point acquisitions moved to its display every 32 milliseconds, the TDS 700A manages a virtual torrent of data arriving at 1GB per second. This decreases the dead time between acquisitions to 1.7us, and allows users to find system glitches much faster than before.

## EA/G-CODE PROMO WINNERS

In the June and July 1994 issues of *EA*, new and renewing subscribers were given the opportunity of winning one of 40 G-Code VCR programming units, each valued at $129. Here are the names of the 40 lucky winners of this promotion:

Mr P. Bullock, Bindoon WA.
Mr D.B. Muller, Grovedale Vic.
Mr McKinnon, Myrtle Bank SA.
Mr C. Papageorgiou, Civic Square ACT.
Baimbridge College, Hamilton Vic.
Mr L. Mackenzie, Seven Hills NSW.
Mr S. Porter, Arncliffe NSW.
Mr Brewer, Croydon Vic.
Mr M.J. McNeill, Yamba NSW.
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Mr J. Hawkins, Malanda, Qld.
Mr A.T. Eade, Turramurra NSW.
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Mr R.F. Howard, Rosanna Vic.
Mr Smith, North Ringwood Vic.
Mr M.J. Foster, Donvale Vic.
Tallganda Electrical, Braidwood NSW.
Mr G.N. Kearns, Padstow NSW.
Mr B. Perry, Bayswater Nth, Vic.
Mr M.C. Wood, Old Toongabbie NSW.
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Mr N.D. Johnson, Frankston Vic.
Mr J.R. Naumann, Port Augusta SA.
Mr Dixon, Mt Waverley Vic.
Mr G. Mansour, Lakemba NSW.
Mr Z.H. Urban, Faulconbridge NSW.
Mr L.E. Sheffield, Ballarat Vic.
Dr R.S. Rosich, Leederville WA.

Our congratulations to these winning subscribers, who have now all received their G-Code Programmers.

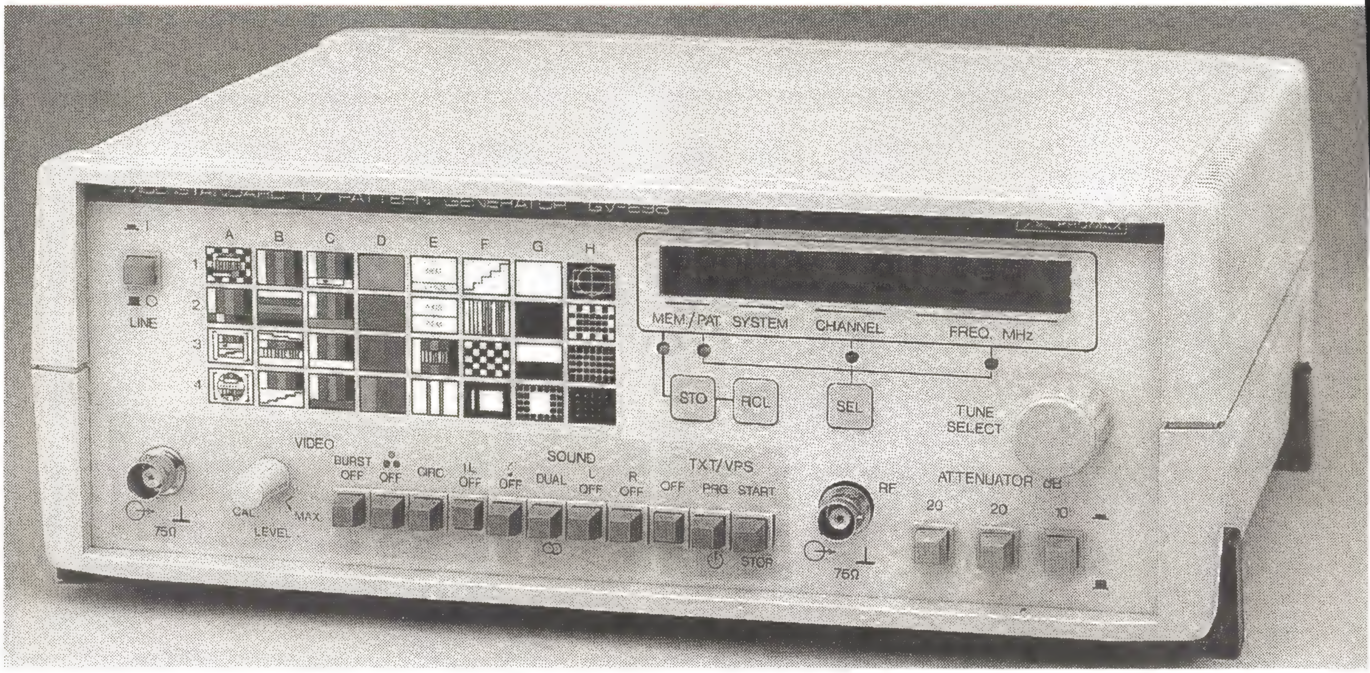
## NILSEN RECEIVES AS 3901 ACCREDITATION

Melbourne based Nilsen Industrial Electronics has received AS 3901 accreditation from Marshall Hayes, Lead Assessor of the National Association of Testing Authorities (NATA), in a ceremony attended by the Executive Chairman of the Nilson Group of Companies, Mr John Nilson, the Group's President Mr O.V.A. Nilsen, executives and employees.

Nilsen Industrial Electronics is the designer and manufacturer of Australia's ground breaking and first fully electronic, microprocessor based, kilowatt-hour meter (MES series), as well as remote meter reading and load control systems, including the innovative Sequential Waveform Distortion (SWD) power line communication system.

Nilsen fulfilled all the requirements for the various facets of AS 3901 (design, manufacturing, administrative procedures, etc.,) in a team effort requiring over 12 months of hard work, said General Manager Jim Watters, when he thanked his executives and employees of the company. ❖

# PROMAX TV SIGNAL GENERATOR

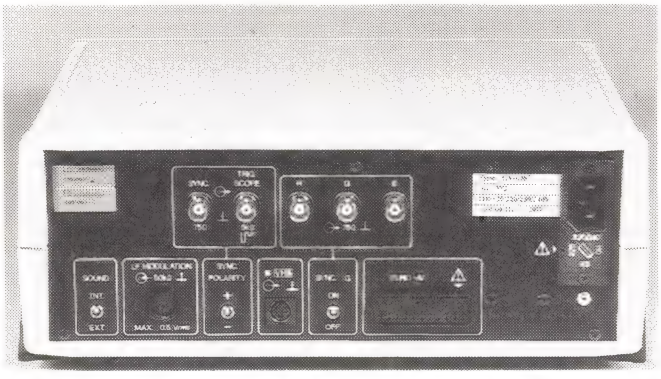


Now available in Australia is the Promax range of TV colour pattern/signal generators, ranging from low cost handheld models to professional benchtop multi-standard units featuring frequency synthesis, digital pattern storage in ROM and full microprocessor control. Here we look at a top of the range model GV-698, which also offers optional test signals for Zweiton stereo sound and Teletext data.

### by JIM ROWE

If you read any of the European electronics magazines, you'll probably have noticed ads in them for Promax test and measuring equipment. Based in Barcelona, Spain, the Promax firm has been producing test instruments for over 30 years and has established quite a reputation for its sound engineering, and instruments that offer high performance at competitive prices.

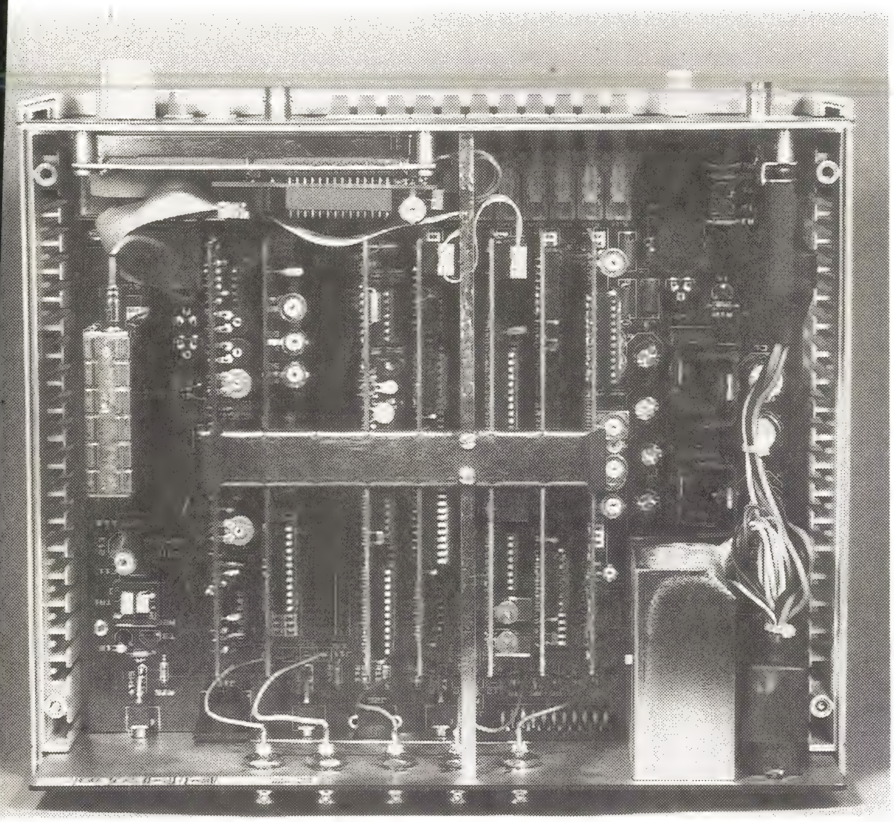
Now Australian firms and individuals will have an opportunity to try out the Promax range of TV colour pattern/signal generators for themselves, as local firm Emona Instruments has become their distributor here. And Emona very kindly made available to us one of the new flagship GV-698 models for review, so that we could try one out on your behalf.



***The back panel reveals just how flexible the GV-698 is. RGB and S-VHS outputs are provided, as is an input for external stereo/audio.***

In their user manual Promax describes the GV-698 as a TV Signal Generator, and in view of its facilities and performance this indeed seems a more suitable title than 'Colour Pattern Generator'. Although its most obvious functions are the generation of any of 32 different video test patterns, it can in fact be used to generate a wide range of TV/video test signals — especially when the available option modules are fitted. These include either Zweiton or Nicam stereo sound (as used in Australia and New Zealand, respectively), Teletext-VPS and special logotypes (which would make the GV-698 suitable for use by small community TV stations, for example).

An important feature of the GV-698, and in fact all of the Promax desktop models, is that the modulated RF output is generated using a digital frequency synthesiser. This gives a much higher degree of frequency accuracy and stability than the tuneable VHF/UHF oscillator fitted to many test pattern generators. The video carrier output tuning range is from 37MHz



***Inside the case, there is ample evidence of good engineering practice. A series of subsystem module cards plug into the main motherboard.***

to 865MHz, which is sufficient to cover all of the Australian and NZ VHF/UHF channels, but not *quite* down to our standard TV IF.

Tuning can be performed in either of two ways. A rotary control at the far right of the front panel allows continuous tuning in 50kHz increments, with the frequency displayed to five-digit resolution on the GV-698's 16 character single-line LCD display. The same control is used to select the TV encoding standard (PAL-B, -G, -H, -D, -K, -K1, -I or -L, or NTSC-M), and also to select any of the 32 available digitally stored test patterns, simply by pressing the appropriate button.

Alternatively you can program and store in memory the picture carrier frequency, channel ID, TV standard and even a default test pattern, for up to 32 different channels, and then select any channel's settings as desired using either a pushbutton or the same rotary control. It's all very convenient.

The rated RF output of the GV-698 is better than 10mV (80dBuV) into 75 ohms, but this can be reduced by up to 50dB in 10dB steps, using a built-in step attenuator. This should be an adequate range for most purposes, giving a minimum output of around 32uV. The RF output is via a front-panel BNC socket.

In addition to the modulated RF output, the GV-698 also provides a composite video output via a second front-panel BNC socket. This has its own output level control, and can deliver up to 1.2Vp-p into 75 ohms — making it very suitable for testing video monitors, VCRs, etc.

The 32 different test patterns available cover a very wide range, and include a full 'monoscope' pattern, colour bars, grey scale, multi-frequency bands, checkerboard, vertical and horizontal rules, crossed-line grid, dots, pure primary colour rasters, 100% white and 100% black, pulse and bar, and various combinations of these. In addition, four front panel control buttons allow the addition of a digitally-generated circle to virtually any of the patterns, and also allow independent disabling of the colour burst, chrominance and raster interlace.

Further front panel buttons are used to provide control of the stereo sound and Teletext/VPS option functions, when these are fitted. For example with either the Zweiton or Nicam sound options fitted, four buttons control sound on/off, stereo/dual mono, and L and R channels respectively.

In some ways, the full potential of the GV-698 only becomes clear when you look at its rear panel. Here you find, for example, connectors which reveal that in addition to its composite video and modulated RF outputs, the instrument also delivers separate R/G/B/Sync outputs (all 75 ohms), via either BNC sockets or a SCART/Euro-AV connector; a Y/C output, via a standard S-VHS mini connector; and a scope trigger output. There's also a switch to select either internal or external stereo audio, and a 5-pin DIN socket for the external stereo audio input. Another switch allows selection of either separate sync or sync-with-G, and a final switch selects the separate sync polarity.

Overall, then, the GV-698 provides an impressive range of functions and facilities. But how does it perform in practice?

## Trying it out

We tried out the sample GV-698, which was fitted with the Zweiton stereo sound option, with a number of different commercial TV receivers and monitors, and also with the new stereo TV sound receiver project that I've been developing. It proved to be very easy to use, and also to deliver very stable and clean test signals.

The ability to set the RF picture carrier frequency accurately is very reassuring, while the programmable RF channel facility allows fast and convenient operation. We also found the wide range of video patterns very handy; there's almost always the right pattern or patterns, for whatever tests you want to do.

Of course the stereo sound option also proved to be very worthwhile, in checking out the performance of the new TV sound receiver!

We opened up the case of the sample unit, to inspect its construction. It turned out to be very well engineered, with a very neat horizontal motherboard at the bottom and a series of equally tidy vertical plug-in boards for each of the main functional subsystems. The power supply uses a small toroidal power transformer, mounted vertically inside a shield bracket.

In short, we found the Promax GV-698 an excellent performer, and one that should meet the needs of many people for a TV signal generator. Considering its performance and flexibility it also seems to represent good value, at the quoted price of $2700 plus tax. The Zweiton or Nicam stereo sound option costs another $317, as does the Teletext/VPS option.

Further information on the Promax range of instruments is available from Emona Instruments, of 86 Parramatta Road, Camperdown 2050; phone (02) 519 3933, or fax (02) 550 1378. ❖

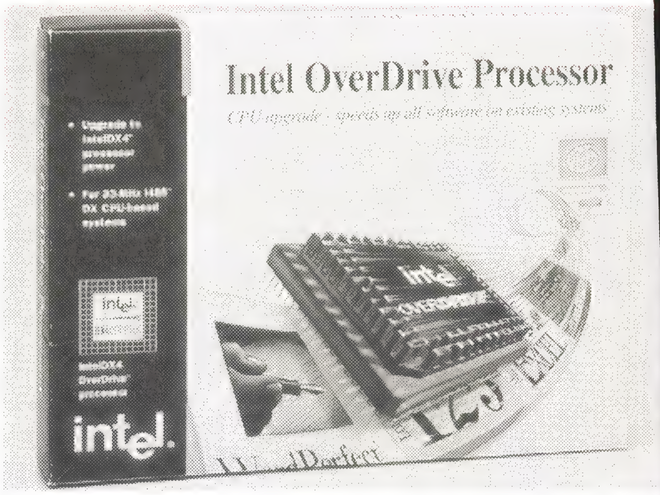
# Solid State Update

KEEPING YOU INFORMED ON THE LATEST DEVELOPMENTS IN SEMICONDUCTOR TECHNOLOGY

## New Intel OverDrive processor

Intel has announced the IntelDX4 OverDrive processor. The new CPU upgrade features 'speed tripling' technology and is available in both 75MHz and 100MHz versions. The new processor is designed to upgrade Intel '486SX and DX CPU-based systems. For example, an Intel '486SX CPU-based system currently running at 33MHz with an iCOMP1 index rating of 136 would operate at 100MHz internally and have an iCOMP index of 435, after being upgraded with the IntelDX4 OverDrive processor. An upgraded 25MHz version of the same system would run at 75MHz internally and have an iCOMP index rating of 319. This translates to an overall performance boost of about 100% for all PC applications.

The IntelDX4 OverDrive processor operates internally at 3.3V yet is compatible with 5V systems via a built-in voltage regulator. It includes an integrated floating point unit and incorporates a 16KB on-chip cache.


Intel OverDrive Processor
CPU upgrade - speeds up all software on existing systems
• Upgrade to IntelDX4 processor power
• For 33MHz i486 DX CPU-based systems
IntelDX4 OverDrive processor
intel

For further information circle 272 on the reader service coupon, or contact Intel Australia, PO Box 1486, Dee Why 2099; phone (02) 975 3300.

## 2.7V op-amp has 10MHz bandwidth

A new wideband op-amp family from Maxim, types MAX473/MAX474/MAX475, have guaranteed operation down to 2.7V. Ideal for single 3V or 5V portable equipment, test and measurement, and wireless applications, these single, dual, and quad op-amps provide significant drive capability.

Each op-amp requires 2mA of supply current yet guarantees a 10MHz unity-gain bandwidth and a 15V/us slew rate, and can drive a load of 600 ohms. The input range includes the negative supply rail and the output swings to within 50mV of each supply rail.

With their fast slew rate and settling time, these devices replace higher supply-current op amps in large-signal applications. The devices are available in 8-pin DIP and SO packages.

For further information circle 275 on the reader service coupon or contact Veltec, 18 Harker Street, Burwood 3125; phone (03) 808 7511.

## 500kHz op-amp operates at 2.7V

Just released are new op-amps from Maxim, types MAX492/MAX494/-MAX495. These are single, dual and quad op-amps that are guaranteed to operate from a 2.7V to 6.0V supply. The input voltage range extends beyond either supply rail and the output swings rail-to-rail (a critical parameter for low voltage systems), which often eliminates the need for a negative supply or pseudo ground.

Precision specifications include an input offset voltage of less than 200uV, an input bias current of less than 60nA, and a guaranteed open-loop gain of 100dB. The devices draw less than 180uA per op-amp and feature a 500kHz unity gain stable bandwidth. Each amplifier is guaranteed to drive a capacitive load in excess of 400pF.

The dual MAX492 and single MAX495 are available in 8-pin DIP and SO packages, and the quad MAX494 comes in 14-pin DIP and SO packages.

For further information circle 273 on the reader service coupon or contact Veltec, 18 Harker Street, Burwood 3125; phone (03) 808 7511.

## RS-232 chip runs on +3V

The MAX3241 from Maxim Integrated Products is an RS-232 interface IC whose proprietary low-dropout output stage enables true RS-232 performance from a +3V supply using only 1mA. The design is implemented with a voltage doubler instead of a less efficient voltage tripler, and is the first in a series of products from Maxim using this new architecture. The IC requires only four tiny 0.1uF external capacitors and is guaranteed to run at data rates up to 120kpbs while maintaining +/-5V RS-232 output levels.

The MAX3241 has five receivers and there are two extra outputs for the fourth and fifth receivers. These receivers can be used to monitor external devices, such as modems. The device can operate from input voltages ranging from 3V to 5.5V. It is ideal for 3.3V-only systems, mixed 3.3V and 5V systems, or 5V only systems.

For further information circle 271 on the reader service coupon or contact Veltec, 18 Harker Street, Burwood 3125; phone (03) 808 7511.

## Support for ISP devices

Zatek Australia have available the latest version of ispStarter Kits from Lattice Semiconductor. The kit contains everything needed to design with Lattice's in-system programmable (ISP) devices, including software, download cable, device samples and data.

As well as supporting the ispLSI1016, the kit also supports the new ispLSI2032 and ispGAL22V10, as well as the new isp Generic Digital Switch.

Samples of the ispLSI2032-80LJ, ispGAL22V10B-15LJ and ispGDS14-7j are included with the kit. A download cable to connect a PC parallel port to the target board is also provided, to allow evice configuration to be downloaded irectly from the PC to the device on the arget board. C++ source code for the in-ystem programming routines (isp-CODE) is provided to allow the user to ort the code to different applications nd platforms.

ISP supports device function programming and reprogramming on a printed circuit board at 5V, which gives several dvantages. First, it accelerates the sys-em and board level debugging process nd enables the board layout to be defined earlier in the design process. As well, ISP eliminates bent leads caused by extra handling and socket insertions made during the device programming process, and systems incorporating ISP are reconfigurable with the devices already soldered to the PCB, minimising board rework time and expense.

For further information circle 274 on the reader service coupon, or contact Zatek Components, 1059-1063 Victoria Road, West Ryde 2114; phone (02) 874 0122.

## Embedded flash RAM

Intel has introduced a new flash memory architecture that combines the high-speed code execution capability of DRAMs with the non-volatile, updatable code storage of flash memory. The 16 megabit (2MB) embedded flash RAMs are designed for high-performance embedded systems where code is typically stored in slow, non-volatile memory such as ROM or disk drive which is downloaded to DRAM at boot-up.

The Intel 28F016XS embedded flash RAM gives faster-than-DRAM performance, due to its 30ns read time. The device has a DRAM interface, making it easy to replace redundant DRAMs with embedded flash RAMs.

Because there's no need to transfer code at boot-up, using embedded flash RAM gives instant-on performance and faster system recovery following a power loss or reset.

The devices are specified for one million erase cycles, and incorporate Intel's SmartVoltage technology which allows the devices to interface to 3.3V and 5V microprocessors.

For further information circle 277 on the reader service coupon, or contact Intel Australia, PO Box 1486, Dee Why 2099; phone (02) 975 3300.

## DSP peripheral IC

The PSD100 from WSI is a field-programmable DSP peripheral that provides program and data storage plus programmable decode logic to access external devices. The PSD100 integrates 128K bits of EPROM, 32K bits of SRAM, a programmable address decoder, user-configurable DSP interface and user-configurable external chip-select outputs, in a high speed architecture that is similar to WSI's family of microcontroller peripherals.

The combined memory access and address decode time of the PSD100 is 35ns. Thus the PSD100 can support high speed word-wide digital signal processors such as the TMS320C50, AD2100 and Motorola 56000/01 without any wait states. The chip select to output time of 17ns enables fast access and address decoding of external chips such as A/D or D/A converters, offchip EPROMs or SRAMs.

The device is ideal for designs that are space limited or require low power consumption, such as high speed modems, digital filters and image processors. It can be configured using WSI's PSDSoft for Windows or MAPLE for DOS development tools.

Device programming can be done using WSI's MagicPro programmer or data I/O programming tools.

For further information contact WSI, 47280 Kato Road, Fremont, CA 94538 USA; phone 510 656 5400.

## Dual frequency PLL synthesiser

The new NJ88C50 from GEC Plessey Semiconductors (GPS) contains two synthesisers, allowing the one IC to cover all frequency generation requirements in analog and digital cellular telephones. The one device can therefore be used as the heart of a fast-locking phase locked loop (PLL) subsystem.

The IC has an integrated fractional-N interpolator that gives the fast frequency locking needed in many of the new digital communication systems. This allows the phase detector to be run at a multiple of the desired channel spacing and provides improvements in both locking speed and phase noise performance.

The main synthesiser in the device has been optimised for performing channel selection and has been designed to operate with an external prescaler for minimum current consumption.

The device is programmed over a three-wire serial bus and data may be clocked in at frequencies up to 10MHz. It operates from a 5V supply and consumes less than 6mA.

For further information circle 276 on the reader service coupon or contact GEC Electronics Division, Locked Bag 29, PO Rydalmere NSW 2116; phone (02) 638 1888.

## MPEG decoder chip

The CL480 is an MPEG-1 audio/video decoder and the first member of C-Cube's PlayCD family. Designed for consumer electronics products and multimedia PCs, the CL480 reduces the system cost by requiring only 4Mb of DRAM, providing CD-ROM decoding, and providing a serial CD interface.

The CL480 reduces development time and effort by performing system stream processing and audio/video synchronisation. It provides high quality output through advanced video post-processing, sophisticated error concealment and support for high resolution still pictures.

For further information circle 290 on the reader service coupon or contact Zatec Components, PO Box 397, West Ryde 2114,; phone (02) 874 0122, fax (02) 874 6171. ❖

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READER INFO NO. 21

# NEW PRODUCTS

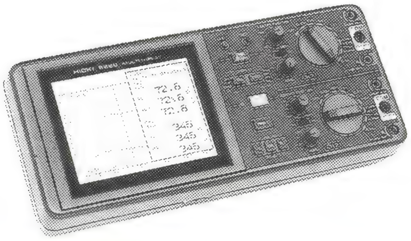
## TEST & MEASUREMENT

### Recording multimeter has two channels

The new Hioki Model 8220 two-channel recording multimeter has a six day storage capacity and can be connected to an external printer via its Centronics interface.

Stored data can be reviewed on a 13cm back-lit LCD screen in five modes including: numeric display of instantaneous values of measured parameters, progressive graphical display of measured points at a minimum of one second intervals, numerical readout of values under the cursor with simultaneous display of maximum, minimum and average as well as elapsed time, minimum and maximum values and their times of occurrence.

The instrument performs true RMS measurements, and can be set to measure voltages up to 500V AC and DC, and currents up to 0.5A AC and DC. It can be used to measure outputs of transmitters and transducers on its low voltage ranges or through the specially provided 4 to 20 milliamp input current ranges on both channels, making it ideal for process control applications.



For further information circle 243 on the reader service coupon or contact Nilsen Technologies, PO Box 930, Collingwood 3066; phone (03) 419 9999.

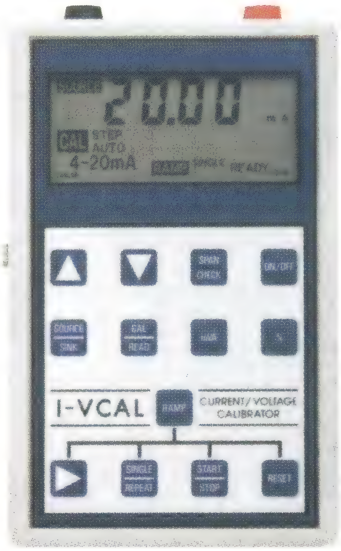
### Current/voltage calibrator

I.D.E. has launched the I-VCAL, a rechargeable, hand-held instrument that can source currents and voltages to suit the calibration requirements of a process control engineer.

On the current range, the instrument sources and simulates 0-52mA (0.025% of range); it has five pre-programmed calibration ranges, and can power two-wire transmitters (24V+ compliance). It can read currents up to 52mA.

The voltage range can read and source process voltages (with 20mA drive capability), and features automatically selected ranges (00.00mV to 9.997mV), with fully protected input and output.

All functions and commands are selected with a wipe clean, tactile keypad with prompting four-digit display indicating loop status, battery condition and the selected function. Weighing less than 500g, I-VCAL is housed in a tough ABS casing. Each unit is supplied with a Certificate of Conformity, traceable to national standards and can be supplied with BS/NAMAS Certification of Calibration if required.



For further information circle 242 on the reader service coupon or contact MTL Instruments, Unit 6 13-17 Sorbonne Crescent, Canning Vale 6155; phone (09) 455 2994.

### VXI compatible instruments

Tektronix has announced a new series of VXI compatible instruments. VXI (virtual test instrument) is a standard for interfacing rack mounted test equipment

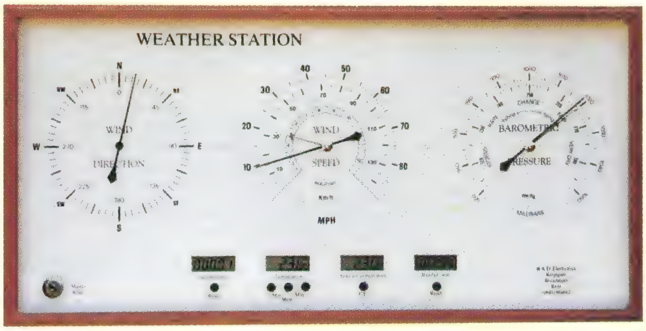
### Electronic weather station

A British company is seeking an agent for its range of electronic weather stations and weather monitors. The monitored parameters depend on the particular instrument, and include wind direction, wind and gust speed, barometric pressure, outside temperature, maximum and minimum temperatures, rainfall, hours of sunshine and wet-bulb temperature for measuring relative humidity and dewpoint.

Maximum wind-speed indication is 145km/h, temperature range is -40° to +50° and the barometric range is 950 to 1050mbar. Resolutions for rainfall and hours of sunshine measurement are 0.01mm and 0.01 hours.

The displays are housed in a glass-fronted mahogany cabinet, and all instruments are linked by cables to external sensors. The infra-red rain sensor doesn't need emptying, and readings for rainfall and hours of sunshine can be reset with buttons on the instrument cabinet.

A large weather station for schools is available and an optional interface allows a weather station to be linked to a computer, so the user can log, graph and analyse meteorological data. The weather station cabinet measures 450 x 180 x 76mm and a monitor cabinet measures 255 x 130 x 55mm.



For further information contact R & D Electronics, 12 Percy Avenue, Kingsgate, Broadstairs, Kent, England CT10 3LB; phone +44 843 866 662.

a computer. The new VXI range inudes a high performance family of VXI aveform analysers, a message-based XI mainframe, a fast VXI arbitrary aveform generator and a series of VXI vitching and scanning modules.

The new additions to Tektronix' VS500 waveform analyser family are he TVS521 and TVS541. These roducts have on-board digital signal rocessing (DSP) capable of providing vaveform maths, signal processing, digial filtering, and a broad range of arametric measurements.

The new VXI410 IntelliFrame mainframe is claimed to be the highest erformance mainframe available in the VXI industry. The 13-slot, C-size mainframe is built for high-performance automated testing applications that require high power and maximum system reliability. Its cooling system provides closed-loop monitoring, control of the temperature rise in each slot, and the ability to block air flow to empty slots. The IntelliFrame offers 1660W of available power.

The new VX4792 arbitrary waveform generator has a 250MS/s sample rate. Replacing traditional function generators, pulse generators, oscillators and synthesisers, the VX4792 is a universal signal source capable of generating extremely complex, high-bandwidth test signals that accurately simulate anything from nominal to worst-cast conditions.

The SurePath relay switching modules reduce switching costs, simplify programming, and speed test program execution. SurePath modules are basic infrastructure products essential for all applications.

For further information circle 241 on the reader service coupon or contact Tektronix Australia, 80 Waterloo Road, North Ryde; phone (02) 888 7066.

## Handheld 'scope

Fluke has released a new version of its ScopeMeter. Called the ScopeMeter Series II, it combines a dual-channel 50MHz digital storage oscilloscope and 3-2/3 digit true-RMS multimeter in a rugged and battery powered handheld unit.

The new model includes a 'Measure Menu' that automatically configures the instrument for any of 30 measurement tasks. Another feature is a Continuous Autoset function that allows the user to move from one test point to another without reconfiguring the instrument. As the user moves from one test point to the next, the Autoset function continues to track the input signal. As the signal changes, the instrument selects the proper timebase, input range, trigger level, slope and source.

Another new feature of Series II is that it continuously displays a waveform view of the input signal, even when the instrument is being used as a multimeter. A better view of the waveform can then be obtained by switching to 'scope mode.

The Series II instruments also include a Min-Max function, which simultaneously graphs the minimum, maximum and average readings of a signal over time, anywhere between two minutes and 30 days.

ScopeMeter Series II test tools are available in four models: three dual-channel versions Fluke 99, 96 and 92, and a single channel model Fluke 91. The 96 and 99 models have a 600V optically isolated RS-232 interface for direct printout to a computer. Model 99 also contains a built-in signal generator capable of producing sine wave, square wave and component test signals. It can also perform waveform mathematics, store 10 screens, 20 waveforms and 40 instrument setups.

For further information circle 245 on the reader service coupon or contact Philips Scientific and Industrial, 34

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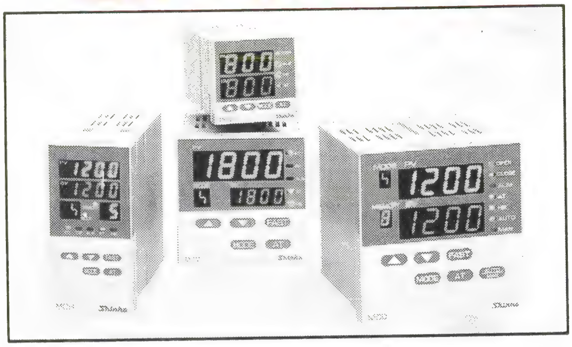

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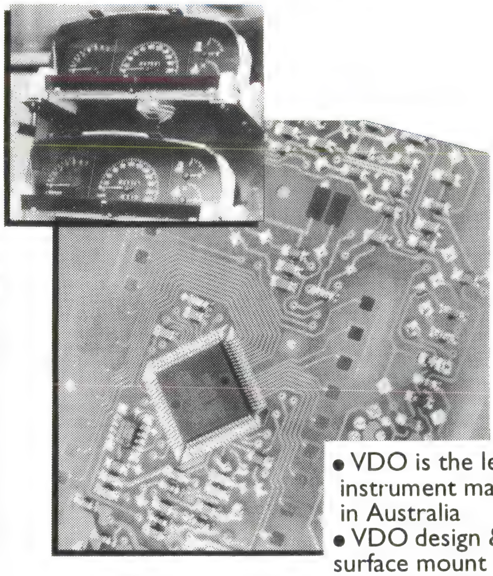
VDO Instruments Australia



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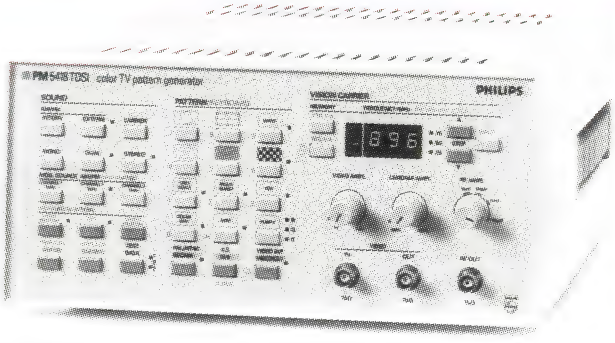
READER INFO NO. 23

## TV signal generator

Fluke has a nounced three new models in its PM 5410 TV signal generator line-up. The new units will be distributed in Australia by Philips, and incorporate BTSC compliant signals for testing MTS stereo/SAP equipped TV receivers. The generators provide 25 different signal combinations and three pre-programmed modes for testing, adjusting and troubleshooting the decoder section of those products that use the BTSC standard. The new test functions provide main channel (L+R), pilot, stereo (L-R) and SAP sound test signals in accordance with BTSC standards.

Available in NTSC M, N and PAL modes, these sound signals are suitable for testing frequency response, alignment, total harmonic distortion, channel separation, SAP level adjustment as well as other aspects of the TV set. The PM 5415C provides test functions for most typically equipped NTSC and PAL products and supports the new 16 x 9 screen size. The PM 5418TDI includes an IEEE-488/GPIB control for remote operation or automated testing applications.



For further information circle 246 on the reader service coupon or contact Philips Scientific and Industrial, 34 Waterloo Road, North Ryde 2113; phone (02) 888 8222.

Waterloo Road, North Ryde 2113; phone (02) 888 8222.

## Digital pressure indicator

A new digital pressure indicator model DPI 145 announced by Druck is designed to perform a wide variety of precision pressure measurement functions in calibration and test laboratories, as well as in meteorological, aeronautical and airfield applications.

A number of sensors can be fitted to cover a wide range of pressures up to 700 bar, with an accuracy of 0.015%. The instrument includes a range of general data processing and inter-channel maths facilities, such as scaling, tare, peak, add and subtract. Specific functions include QFE, QFF, three-hour trend, barograph, altitude and leak test.

The instrument has a high-contrast display panel, which can be set up to display from one to eight parameters, in a text size to suit. Data logging facilities allow the unit to store data which can be recalled to the display, or sent to a printer or a computer.

For further information circle 247 on the reader service coupon or contact Davidson, 17 Roberna Street, Moorabbin 3189; phone (03) 555 7277.

## Handheld laser source

Wandel & Goltermann has launched a new range of three hand-held laser sources. They are designed for use during installation, maintenance, troubleshooting or repairing wide-area systems of passive optical networks.

The OLS-15 is a dual laser source for 1310nm and 1550nm with a common output for both wavelengths. The OLS-16 and OLS-17 are single sources for 1310nm and 1550nm respectively. The source output level is -7dBm.

When used with the OLP-15 optical level meter, OLS-15 allows simultaneous measurement of attenuation at two wavelengths. When used with the three sources in auto-lambda mode, the OLP-15 automatically recognises the received wavelength and sets itself to measure attenuation at the corresponding calibrated wavelength. A further feature is the ability to modulate the output signal with 270Hz, 1kHz or 2kHz.

The laser sources are ruggedised and shock-resistant, so they can be used under difficult field conditions. They can be powered from dry batteries, rechargeable batteries or from a separate AC power supply. Operating time from batteries is around 15 hours. The test adaptors can be exchanged easily to allow matching to the usual types of connector, such as FC, SC or DIN. The connector on the instrument can also be easily accessed for cleaning or inspection.

For further information circle 244 on the reader service coupon or contact Wandel and Goltermann, 42 Clarendon Street, South Melbourne 3205; phone (03) 690 6700.

# SOLDERING

## Printer applies SMT paste

A compact screen printer developed in the UK by SMTech that can apply solder paste to surface-mount PCBs is now available in Australia. The device, called the AVP300, can print on densely populated boards, even if components are mounted on the underside. It is controlled by software that runs under Windows.

The printer is designed for in-line operation on boards ranging from 75 x 55mm to 400 x 460mm. Maximum print area is 380 x 460mm and maximum print stroke is 400mm. Registration accuracy

+/- 0.00063mm and the print speed is -70mm per second.

For further information circle 249 on e reader service coupon or contact achinery Forum, 33 Brodie Street, ydalmere 2116; phone (02) 638 1566.

## onvection module for reflow oven

Heraeus Noblelight has developed a onversion module for its infra-red eflow ovens which facilitates forced cir-ulation of air in the reflow zone. Called forced convection module, air flowing rom a blower is heated and blown onto he circuit board through specially configured rows of holes.

The reflow oven is then a combination of medium wave infra-red radiation and forced circulation of air. The IR emitters provide a well-directed and controlled heat transfer with a high degree of efficiency, and the forced air causes greater homogeneity in temperature distribution on the circuit board.

A simple conversion of existing ovens will enable operators of the Infradry Reflow Oven from Heraeus to benefit from the advantages offered by the combined methods of heat transfer.

For further information contact Heraeus Holding GmbH, Postfach 1561, D-63405 Hanau Technical Press Department; phone +6181/355 211.

## Desoldering braid handheld dispenser

The Wickgum braid dispenser from Xuron fits comfortably in the hand, and has a thumbwheel to advance or retract the braid. By squeezing the trigger the operator can cut off the used braid. There are no plungers to push, spring loaded levers to cock or vacuum chambers to empty.

Burns can be avoided as the braid does not need to be touched. The operator stays clean and the desoldering braid is not contaminated by finger oil or other foreign matter.

Special features include interchangeable cassettes, factory loaded with 4.6 metre lengths of pure copper braid impregnated with water clear flux. Cassettes are available in four braid widths: 0.889mm, 1.524mm, 1.93mm and 2.794mm. Both the Wickgun and its replacement cassettes are manufactured from static dissipative plastic so they can be used in electrostatic discharge (ESD) control programs.

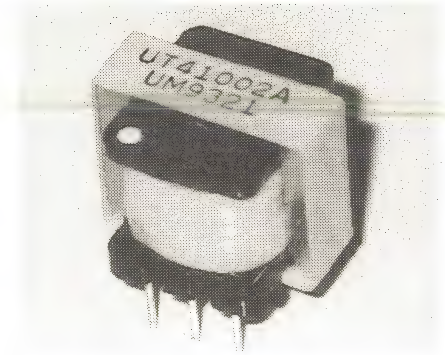
For further information circle 248 on the reader service coupon or contact Electronic Development Sales, PO Box 822, Lane Cove 2066; phone (02) 418 6999.

# COMPONENTS

## Austel approved telephone transformer

Alpha Kilo Services has available Austel approved telephone interconnect transformers, part number UT41002A. The operating temperature range is from 0 to 55°C, the isolation voltage is 1500V AC (RMS) between primary and secondary and to core, and 500V AC RMS from secondary to core.

The power level is -45dBm and the harmonic distortion is 0.5%, at 300Hz 0dBm. The turns ratio is 1:1 and the dimensions of the transformer are 17.5 x 19.6 x 19.6mm (HxWxD).



For further information circle 252 on the reader service coupon or contact Alpha Kilo Services, 1/144 Burns Bay Road, PO Box 180, Lane Cove 2066; phone (02) 428 3122.

## Fibre optic TX, RX for CATV

Optical Systems Design has announced the release of its Australian designed and manufactured OSD481/OSD483 CATV fibre optic transmitter/receiver pair, intended for applications where a number of television signals must be transported over distances of up to 20km.

The units can be configured either as point to point links or as a star network with one transmitter feeding several remote receivers via an optical splitter, which can be located at the transmitter or at an intermediate location.

The OSD481 transmitter accepts a combined AM-VSB spectrum signal at a level of about 90 to 100dBuV/channel with carriers in the range 40 to 860MHz.

The OSD483 receiver is a wideband PIN photodiode receiver which outputs

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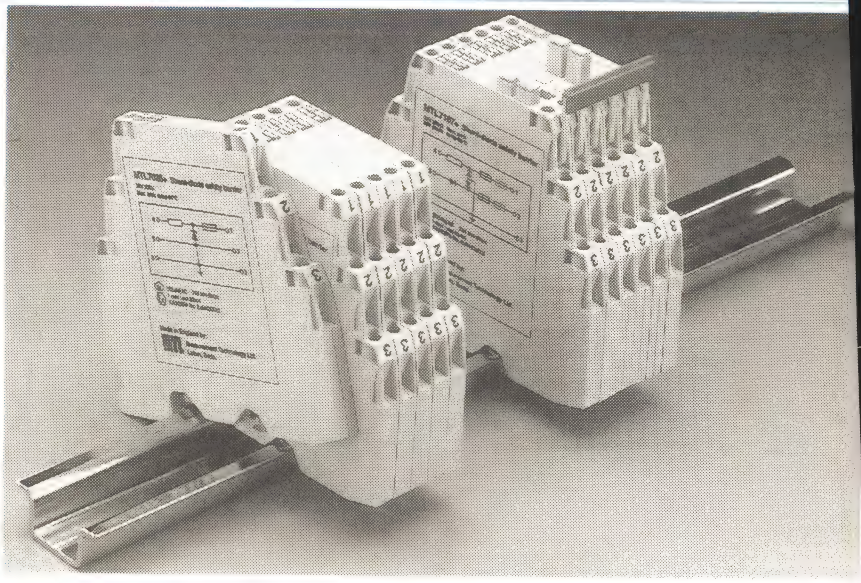


## Safety barriers are only 7mm wide

A new range of slimline shunt-diode safety barriers featuring elements previously beyond the reach of certified intrinsic safety circuits, has been developed by Measurement Technology for interfacing with hazardous area instrumentation.

Called the MTL700 series, the new safety barriers have a width of 7mm, achieved through the use of surface mount technology, ceramic circuit boards and thick film printed resistors.

Similar in size and appearance to conventional field terminals, the MTL7000 Series features an integral disconnect facility for isolating safe and hazardous area circuits. Depending on the user's installation strategy, this allows the new barriers to double as field terminals.

The barriers are clamped and earthed simultaneously on to a standard DIN rail, specially treated for protection against corrosion.

For further information circle 251 on the reader service coupon or contact MTL Instruments, Unit 6 13-17 Sorbonne Crescent, Canning Vale 6155; phone (09) 455 2994.

the combined FDM spectrum at a level of about 100-105dBuV/channel.

The OSD481 and OSD483 are packaged as standalone 120V/240V AC (60V AC optional) powered table-top mounting units. The OSD481 is available in this format with optional optical splitters to support star configured networks.

Applications include multi-channel CCTV systems, campus audio/visual reticulation networks, CATV/MATV networks in resorts and other large sites.

For further information circle 250 on the reader service coupon or contact Optical Systems Design, Unit 5, Vuko Place, Warriewood 2102; phone (02) 913 8540.

## Sunlight readable VGA LCD display

An LCD display from Japan that can be viewed under lighting conditions from direct sunlight to complete darkness has been released by Optrex.

In dark conditions, the cold cathode fluorescent backlight provides illumination, and in sunlight the device behaves as a standard reflective-backed LCD.

The display, model DMF50260NF-SFW is housed in a package measuring 260 x 174 x 6.5mm. The 640 x 480 pixels are capable of displaying standard VGA graphics in a viewing window of 196 x 148mm.

Applications include mobile vehicular mounted displays, toll booths, outdoor truck loading and weighing stations, mine sites, freight handling sites and wherever lighting conditions vary between extremes. The display can be interfaced to a PC via an Allus display controller board, or it can be driven directly by specially configured single board computers from Amtex.

For further information circle 253 on the reader service coupon or contact Amtex Electronics, PO Box Box 285, Chatswood 2057; phone (02) 805 0844.

## ouch programmed, sensitive lamp

The Noval Smart Lamp from OTR is a uch programmable lamp which uses a ssive infra-red detector to sense move- ent and automatically switch on the mp. The lamp can distinguish between ght and day and can be set to automat- ally switch itself on at night.

The lamp senses the infra-red radiation mitted from a human body, and the mp stays on as long as there is movement from someone in the room. It will turn itself off after a predetermined interval (from one to 20 minutes). If the room is already lit, the lamp will not come on.

The lamp can be programmed to switch on when the light level falls below a given level, and will switch itself off when the ambient light increases above a preset level. A manual override allows the lamp to function in the normal way.

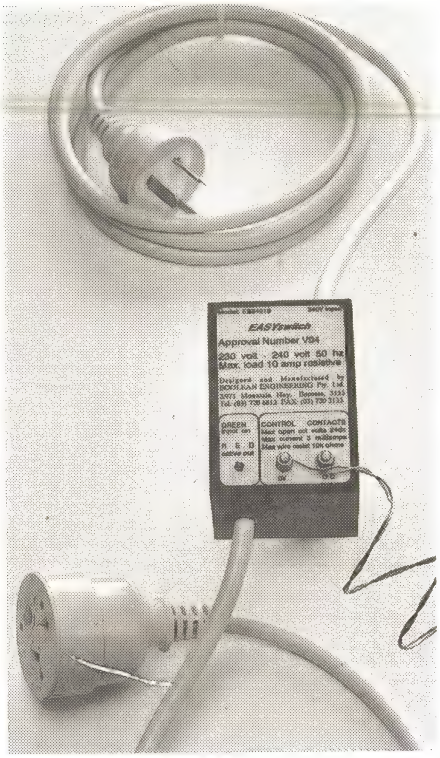
The lamp is programmed into any of its three modes by touching the side of its non-metallic sensor unit. It can also be operated from a light dimmer.

For further information circle 253 on the reader service coupon or contact OTR Corporation, 119 Willoughby Road, Crows Nest, Sydney 2065; phone (02) 906 1462.

## Remote 240V switch

The Easyswitch has been designed to resolve a long standing problem of how to control mains power supply safely and economically.

The new device is an approved but inexpensive remote switching system for 230/240 volt AC 50Hz 10amp (resistive) loads. Easyswitch comes complete with flexible power leads that can be simply plug-connected between equipment or appliances and a power outlet. A remotely located short circuit applied to the control terminals, over many kolmetres of bell wire or signal wire, will switch the mains supply to the connected load via an internal power relay.



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The remote short circuit can be supplied by a push button, relay contact, limit switch, open collector transistor, etc.

Because only a voltage free circuit closure is required, no power supplies external to the device are needed. Consequently Easyswitch can be used with controllers like PCs, security equipment, PLCs, control panels, movement light and heat sensors, audio visual equipment or in safe isolation by manual operation.

The controller measures 75 x 50 x 40mm, weighs only 600g, and its complete encapsulation ensures trouble free use in almost any environment. A LED indicates the operating condition of the device, which is rated at 2 x 105 electrical operations with a 240V 10A resistive load.

Easyswitch is priced at $89 each plus $20 sales sales, if applicable. For further details circle 270 on the reader service coupon or contact Boolean Engineering, 971 Mountain Highway, Boronia 3155; phone (03) 720 6813 or fax (03) 720 2133.

### Cordless phone batteries

Panasonic has introduced a range of replacement cordless phone batteries that will be available from electrical retail outlets.

The rechargeable batteries suit a variety of cordless phones, including Panasonic, Sanyo and Uniden.

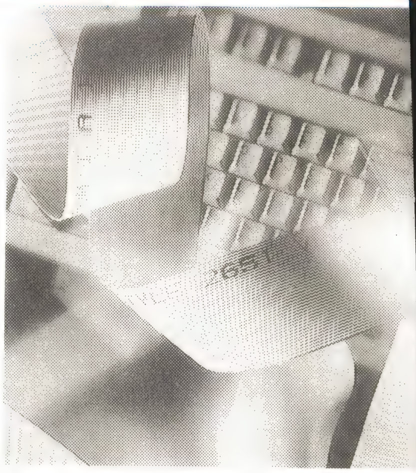
Informatioon which model phone a battery suits is given on the back of the package containing the battery. The batteries are recyclable and can be returned to Panasonic Australia for recycling. The recommended retail price is $30.

For further information contact Panasonic's Customer Care Centre on 132 600.

## WIRE & CABLE

### Miniature ribbon cable

Belden has released a new miniature 1mm pitch ribbon cable for computer and computer peripheral applications. It also suits the 2mm IDC connector for disk drives.



The cable, 2L280XX is a grey extruded PVC flat cable with a black polarity stripe. Conductors are stranded 28AWG (7x36) tinned copper, and the cable is available with conductor coun of 26, 34, 40, 44 and 50. The cable mee the electrical performance requiremen specified for the SCSI-3 parallel inte face. Key parameters include singl ended (ground-signal-ground) impedance, attenuation at 5MHz and maximum DC resistance. The voltage an current ratings are 300V RMS and 1A.

For further information circle 254 o the reader service coupon or Belden International, PO Box 316, South Yarr 3141; phone (03) 826 0448. ❖

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Herman Nacinovich, ETI review "It's a Breeze" Jan. 1990.

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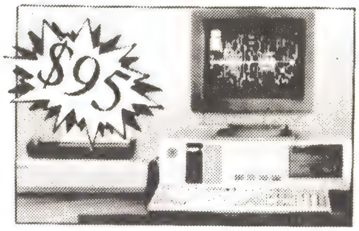

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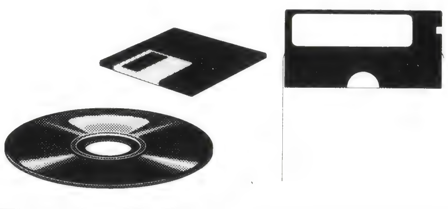


## Intusoft's ICAP/4 Windows

Earlier versions of Intusoft's *IsSpice* suite of circuit simulation software were reviewed in the July and October 1991 issues, and also in the July 1993 issue. Here we look at the new Windows-based version, which offers not only enhanced schematic entry and waveform display modules, but a new and even more powerful simulation engine — now offering a high degree of user interaction.

**by JIM ROWE**

When we last reviewed the *IsSpice* suite of analog circuit simulation programs, in July 1993, they had been upgraded significantly from the versions that were first released.

The schematic entry program *SpiceNet 3.0* and text editor *IsEd* had both been revamped, and given the same proprietary DOS-based graphical user interface as their *IntuScope 3.11* post-simulation 'software scope' program. Also the then-new *IsSpice3* simulation 'engine' program had been completely rewritten, and based on Berkeley SPICE 3E.2 (but with syntax compatibility with SPICE 2G.6). This made it not only more powerful and faster (about twice as fast as the previous *IsSpice/386*), but also allowed it to provide on-screen progress plots of circuit parameters, during the actual simulation.

These features gave such a big boost to the performance and ease of using the new suite, that like other reviewers I couldn't help but be impressed. I did have a few complaints about some remaining 'rough edges' (especially with regard to upgrading from earlier versions), but on the whole I found it both dramatically easier to use than previous versions, and at the same time an extremely powerful and valuable circuit design tool — one that was very reasonably priced, as well.

It turns out that Charles Hymowitz and his team of simulation experts at Intusoft haven't rested on their laurels since then.

Their latest achievement has been to jettison their old proprietary GUI and port the whole thing across to *Windows 3.1* (and also *Windows NT*), to take advantage of the broader range of printer, display and other facilities available on this platform.

At the same time, they've also revamped the simulation engine yet again, and given it even more power and flexibility. The new *IsSpice4* engine is a 32-bit program, using the 'WIN32s' extensions for *Windows 3.1* or *Windows NT*, and is also fully *interactive*. This means that it doesn't just plot pre-specified circuit parameters during the simulation; now you can do things like:

- Start, stop, pause and resume simulation at will, without having to jump back into the schematic entry program or text editor to modify the circuit or netlist, before a new 'run'.
- Change or sweep single component parameters, groups of parameters or global circuit parameters, and watch the effect on circuit performance.
- Look at the voltage or current waveform at virtually any point in the circuit, by using a 'probe' cursor to click on node or component symbols on the schematic, *while the simulator is running*.

It's mighty powerful and impressive stuff, and in fact *IsSpice4* is claimed to be the first and only fully interactive version of SPICE to be produced to date. And all this simulating power runs on your 386 (with coprocessor), 486 or Pentium-based PC (there are also versions for a Macintosh, DEC Alpha or MIPS machine, also with a coprocessor).

*IsSpice4* is a derivative of the improved and updated Berkeley SPICE 3F.2, a later version than its predecessor *IsSpice3*. However like the latter it has many features to ensure backward compatibility with SPICE 2 model libraries, etc. For example it automatically converts SPICE 2 'polynomial syntax' definitions of dependent sources to the newer nonlinear syntax.

Other enhancements included in *IsSpice4*, perhaps less obvious but also important, are improved DC and AC convergence properties; a new pole-zero transfer function; new MOSFET level 2 and lossy transmission line models; voltage and current controlled switches with hysteresis; a GaAs MESFET model based on the Statz model; and a new JFET model based on the work of Parker and McCament at Macquarie University.

By the way because *IsSpice4* is based closely on Berkeley SPICE 3F.2, this means that its companion programs in the new *ICAP/4 Windows* suite are individually and collectively also compatible with other Berkeley SPICE-based simulators. So people with an existing simulator can also use these 'support' programs to provide it with *Windows*-based schematic capture, text editing, pre-processing and post-simulation display/printing capabilities.

Mind you, once they see the power available with *IsSpice4*, they might rapidly lose interest in their existing simulator...

### Trying it out

Intusoft very kindly made available a sample *ICAP/4 Windows* package for review, via its local distributor ME Technologies. This allowed us to both try it out, and also compare it with the earlier versions.

The first thing we found was that as the first of the *Windows*-based Intusoft packages, it was much easier to install — with no complications due to changes from earlier versions, etc. Like other *Windows*-based packages, it was simply a matter of putting the first distribution floppy in the drive, and calling Program Manager to run the Setup program...

h, there is an important point I en't mentioned, yet. The new *ICAP/4* *dows* comes with a hardware security ice or 'dongle', which must be con- ted to your PC's printer port before package will run.

know many software users *hate* ngles, as they seem to be capable of sing strange malfunctions with other ftware. Also with so many software ckages using one nowadays, many us are also finding our computers owing messy protuberances from eir printer ports — rather like nocchio's nose!

Still, I can understand why so many ftware developers have chosen to go th a dongle; they're probably the ly way to protect their investment ainst piracy. I gather that Intusoft und quite a bit of unlawful copying of s software, and was reluctantly forced 'dongle-ise' it...

We found all of the new *Windows-* ased enhancements to *SpiceNet*, *Pre- pice* and *IntuScope* very nice indeed, nd similar enough in operation to the revious versions to minimise any re- earning. Our earlier circuit files loaded nto *SpiceNet* without any hassles, apart rom having to make minor changes to omponent and label colours so we could ee them again!

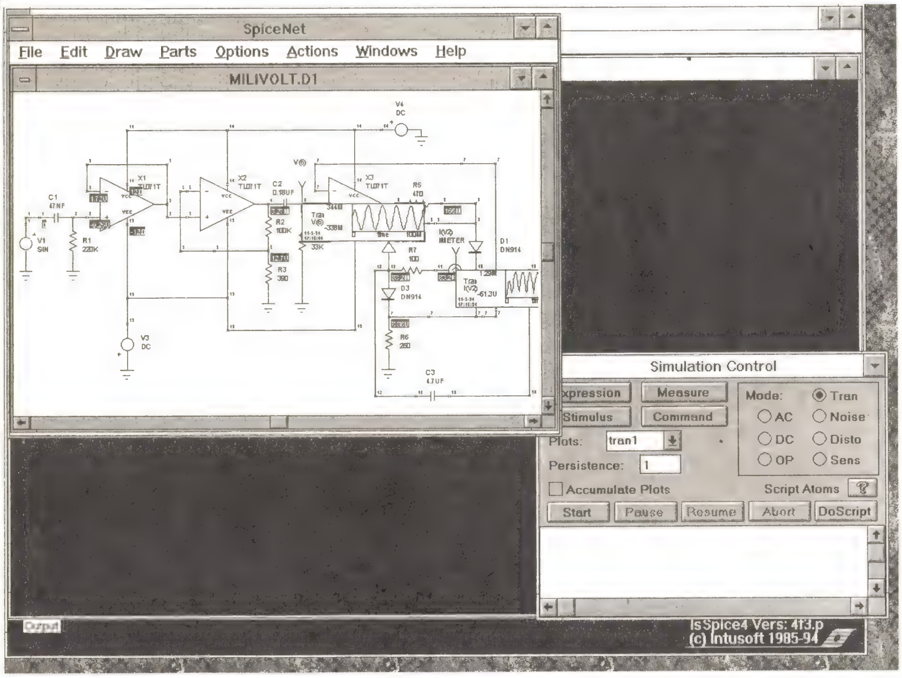
The new interactive *IsSpice4* engine is something else again, though. It takes a ittle while to get used to having a more 'friendly' simulator that you 'talk to' directly, rather than the earlier versions which simply processed your circuit file and produced an output file for you to look at afterwards. Even *IsSpice3* with its 'during the run' on-screen curve plotting was still a long way from achieving the level of flexibility and user-interactivity provided with the new program.

I'm still learning how to make the most of this new level of simulator interaction, but I've seen enough to know that this is the only way to go. It's undoubtedly the way simulators need to be, to allow us to use them as a really effective design tool.

On the speed side, checking it out with the same test circuit files I used with previous versions suggested that *IsSpice4* is not *quite* as fast as its immediate predecessor (running on the same 486/33MHz machine). But it's still very quick indeed, taking only 15 seconds all up to do a transient simulation on the D&N Meter's metering circuit. This is excellent, considering all of the new interactive features.

I must also note that Intusoft has also done a major upgrade with the *ICAP/4* user manuals. These seem considerably more informative than the earlier manuals, and organised so that it's rather easier to find things when you need them...

All told, then, the new *ICAP/4 Windows* package is a big improvement over the earlier versions, in every respect. With their porting of the *IsSpice* program suite over to the *Windows* platform and development of the new interactive engine, the Intusoft team has produced a really outstanding PC-based circuit simulation system.



***While the simulator is still running, you can open up the schematic in SpiceNet, and use the 'probe' tool to look at circuit waveforms. The simulation control panel (lower right) remains available, to allow running further simulation runs.***

The only sobering news is that the full *ICAP/4 Windows* package now costs a rather solid $4020, plus $15 courier fee within NSW, or $20 to other states by air delivery. This does not include things like the device modelling program *SpiceMod*, the Deluxe Model Library or the RF Device Models — which are available either separately, or collectively as the *ICAPS Deluxe Option* for $659 (includes the *Spice Applications Handbook* and the *Spice Cookbook*).

Although this is not *really* expensive, when you consider the simulation power it provides, nevertheless it's probably going to be outside the reach of many. With this in mind, Intusoft has now also released a 'little brother' version called *ICAP/4 Lite*, for a somewhat more accessible base price of $895. This offers many of the features of the full package, but with some of the more esoteric functions removed.

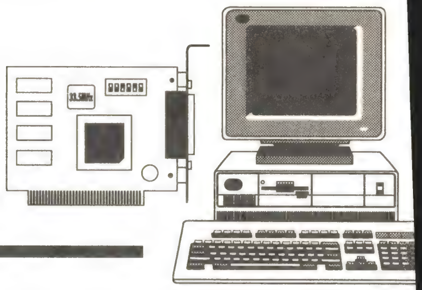
For example you can only enter a one-page circuit; there's no 'cross probing' to let you bring up waveforms on the schematic; you can't edit the schematic symbols; it cannot simulate GaAs MESFETs, lossy transmission lines or a few other specialised devices; there are only 500+ models, instead of 4000+; and you can only do DC, AC and transient analyses — although there's no limit to circuit size. It's still a *very* powerful package, and would probably be more than enough to meet the needs of many people.

Even lower in price again is a new *ICAP/4 Students* version, which sells for only $99 plus $10 certified postage. This version provides considerably less, as you'd expect, but it's still capable of schematic entry (less than 15 symbols), limited simulator interaction, real-time display and DC/AC/transient simulation. It includes a model library of 75 parts and comes with the *ICAP/4 Lite Users Guide*, so it would make an excellent introduction package.

An upgrade program is available to allow owners of earlier Intusoft packages to take advantage of the new developments at a favourable price. And of course Intusoft still offers its highly regarded technical support service, with free modelling assistance for registered customers.

For further information on any of the new *ICAPS/4* simulation products or upgrades, contact ME Technologies at PO Box 50, Dyers Crossing 2429; phone (065) 50 2200, or fax (065) 50 2341. ❖

# Computer News and New Products



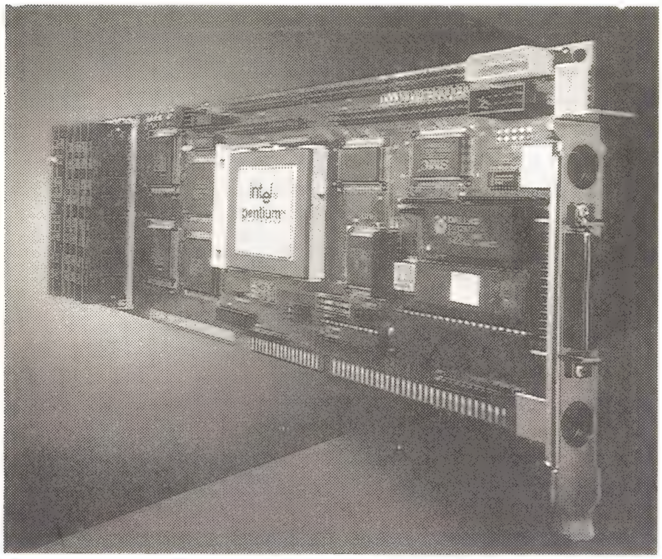
## Pentium CPU card with PCI/ISA bus

The latest addition to the line of Advantech Industrial Grade CPU cards is the PCA-6156, built around Intel's Pentium 60/66MHz CPU. The card features PCI and ISA local buses and supports from 2MB to 192MB of DRAM. It also has a fast PCI SCSI-II interface, four enhanced PCI IDE HDD interfaces and two FDD interfaces.

Other features include two RS-232 serial ports (with 16C550 UARTs) and one bi-directional parallel port (ECP/EPP compatible). In addition to the Pentium's 16KB cache memory, the card has an extra 256KB second level write-through cache.

The Pentium runs at twice the speed of current '486 CPUs and performs an extensive internal test each time it's reset, checking its hardware and internal microcode that covers 70% of the Pentium's operations.

The card's 32-bit local PCI bus offers data transfer speeds up to 132-MB/s, compared to ISA speeds of only 8MB/s, giving increased performance of high bandwidth applications such as graphics, video and LANs.



For further information circle 163 on the reader service coupon or contact Priority Electronics, Suite 4 and 5, 23-25 Melrose St, Sandringham, 3191; phone (03) 521 0266.

## Quad speed CD recorder

SCSI Corporation has announce the release of the Yamaha CDE-10 and CDR-100 recordable compa disc units. The quad speed CD re corder can write 650MB in 1 minutes, and is available as an inte nal (CDR-100) or external (CDE-100 configuration. The unit is compatibl with all standards of CD recording including CD-DA (digital audio), CD ROM (data image, video), CD-ROM XA and CD-I (interactive).

The unit has three recording modes record whole disc in one sitting; recor part of the disc, then record again up t 99 times; and multi-session mode (record part, read in the interim, ad data later until disc is fully recorded) Recordings can be made at selectable speeds of x1, x2 and x4.

SCSI Corporation is supporting these units with compatible software including Gear and Alchemy, a data management software which links to Gear to provide indexing, archiving and retrieval of all types of data, images, text and data bases.

The CDR-100 is priced at $7836.00 retail and the CDE-100 is priced at $9526.00. Gear has an RRP of

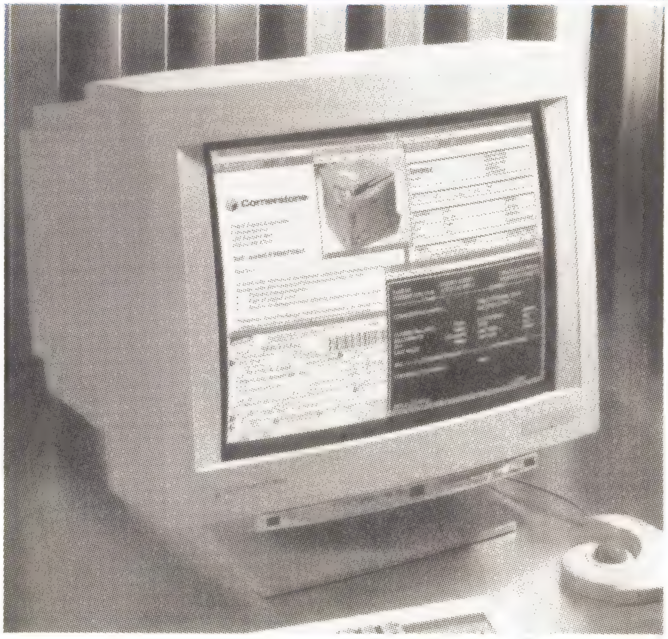
## 20" colour monitor operates at 70Hz

Cornerstone Imaging's new digital colour display system is targeted at document imaging applications. The new product, called the Color 20/70, features a 20" flicker-free, high resolution display with antiglare coating. The Color 20/70 subsystem includes Cornerstone's display controller technology, which has image enhancement and image decompression acceleration.

Fundamental capabilities of the 20/70 include high resolution and 1600 x 1200 operation at a flicker-free 70Hz refresh rate. The product's fully digital design allows precise control of geometry and lets users set many screen functions such as display size, centreing, brightness and contrast.

The Color 20/70 is compatible with both ISA and Micro Channel bus, and has Microsoft Windows and 0S/2 Presentation Manager driver support. Suggested list pricing for the complete subsystems is $7495 for ISA, and $7595 for Micro Channel configurations.

For further information circle 162 on the reader service coupon or contact Mitsui Computer, PO Box 234, Frenchs Forest 2086; phone (02) 452 0452.



1344.00 (retail), and Alchemy retails om $1516.00.

For further information circle 161 on e reader service coupon or contact CSI Corporation, 19/9 Hudson venue, Castle Hill 2154; phone (02) 94 6033.

## cross compilers orrect errors...

HI-TECH Software has announced ew versions of its C cross compilers or embedded systems. The most common eight and 16-bit microprocessor chips are supported by the compilers, which produce code comparable to hand-written assembler.

New features in the latest versions include automatic correction of common programming errors, such as missing semicolons and unspecified header files. The inbuilt editor provides syntax-directed editing of C source programs, with automatic indenting to show program structure, and colour highlighting of C reserved words, identifiers and comments.

Support is now provided for non-volatile RAM, allowing C programs to directly control and use blocks of battery backed RAM for storage of operating parameters and other non-volatile information.

Further refinement of code generation algorithms has resulted in the generated code being even smaller and faster than previous versions.

Supported processors include the 68HC11, 68HC05, 68000, Z80, Z180, 8051, 80C188, H8/300 and 6809. New compilers being released support the Microchip PIC series, and the new Philips XA (eXtended Architecture) chip, providing an upgrade path from the 8051. Upgrades are available to registered users of earlier versions.

For further information circle 164 on the reader service coupon or contact Hi-Tech Software, PO Box 103, Alderley 4051; phone (07) 300 5011.

## SPICE for Power Macs

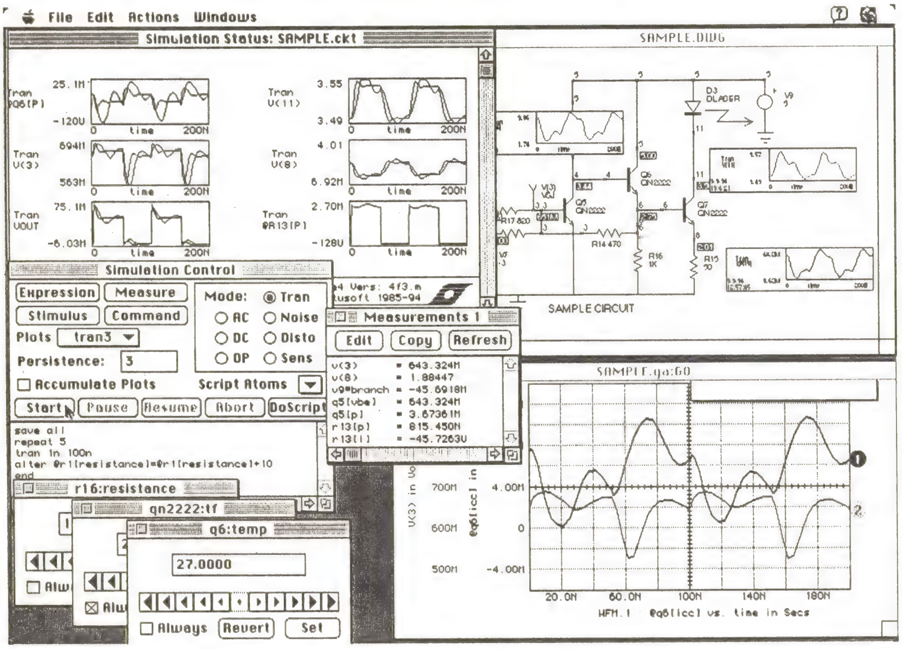
A native version of Intusoft's CAE Tool, ICAP/4, is now available for the Power Macintosh computer. ICAP/4 is an analog and mixed signal simulation system used by engineers to design and analyse electronic circuits.

It is claimed to be the first and only native version of the popular Berkeley SPICE 3 program available for the Power Macintosh. Intusoft has also introduced a 'no co- processor' version of ICAP/4, allowing Macintosh Powerbook and LC users to benefit from its CAE tools.

The ICAP/4 Power Macintosh system includes an integrated schematic entry program to draw the circuits, extensive SPICE model libraries with over 3000 models, advanced IsSPice3 analog and mixed signal simulator based on Berkeley SPICE 3F.2, and graphical waveform processing.

Simulating applications such as mixed analog and digital ICs, PCB transmission line effects and high speed board layout, and mixed domain (mechanical, electrical, physical) systems on the Power Macintosh is now possible with ICAP/4.

For further information circle 170 or contact ME Technologies, PO Box 50, Dyers Crossing NSW 2429; phone (065) 50 2200.



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```
save all
repeat 5
tran 1n 100n
alter @r1[resistance]=@r1[resistance]+10
end
```

```
v(3)        = 643.324M
v(8)        = 1.88447
v9#branch   = -45.6918M
q5(vbe)     = 643.324M
q5(p)       = 3.67361M
r13(p)      = 815.450N
r13(i)      = -45.7263U
```

q6:temp 27.0000

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☎ 065 50 2200, 🖹 065 50 2341

READER INFO NO. 34

## Disk storage

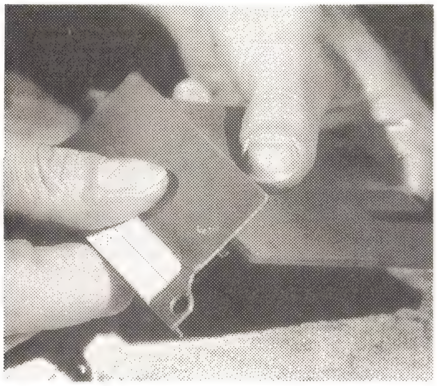
Toolmark Australia have announced Snap, a new storage system for computer diskettes which it claims solves most of the identification and handling problems commonly associated with their use. Heart of the Toolmark system is the Snap DisController, a plastic device which clips onto any 3.5" diskette, forming an easily handled extension.

Once the DisController is attached, there is no longer any danger of touching the surface of the disk — so reducing any chance of disk damage. The extension also makes the disk easier to remove from the drive, particularly with stubborn disks or worn disk drives.

The extension carries a title tab to allow the identification of each diskette, with the information repeated on the front edge, like the spine of a book. Ring binder holes in the DisController permit easy disk filing along with relevant paperwork in standard ring binders.

The recommended retail price is $7 for a pack of ten, and DisControllers are stocked by most computer stores around Australia including Dick Smith, Harvey Norman, WC Penfold and Macquarie Stationery.

For further information circle 173 on the reader service coupon or contact Toolmark Australia, 63 West Street, Crows Nest 2065; phone (02) 955 7375.



## Notebook LAN and WAN analysers

Wandel & Goltermann has released its newest family of network analysers. Developed for the field service market, DominoLAN and DominoWAN operate under a Microsoft Windows-based user interface running on a standard notebook PC.

Interface buttons allow users quick access to analysis functions for monitoring, examining, transmitting and capturing data. Users can configure one or more DominoLANs and DominoWANs in any combination, to generate and monitor traffic through multiple interfaces simultaneously. The DominoLAN incorporates both Token Ring and Ethernet interfaces in one unit.

For further information circle 169 on the reader service coupon or contact Wandel & Goltermann, 42 Clarend
Street, South Melbourne 3205; pho
(03) 690 6700.

## Fast 3D video card for PCs

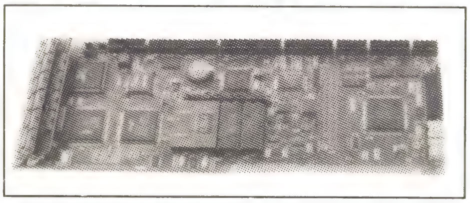
The new Impression Plus is a single plug-in board that offers 3D graphics within a Windows or multimedia environment. This new 64-bit graphics accelerator offers fast Windows performance at all resolutions and colour depths.

Features include MGA PowerDesk for optimised Windows, Dyna View for 2D and 3D CAD as well as a 3D CD-ROM games pack. The card has a high level of performance in eight, 16 and 24-bit colours with over 40 million Winmarks in Ziff Davis' WinBench 4.0.

A new function called Packed Pixel enables acceleration of 24-bit colours at resolutions of 1280 x 1024. The board provides a 90Hz refresh at 1280 x 1024 resolutions, and 120Hz at 1024 x 786. With a 220MHz DAC, it reaches 85Hz in 1600 x 1200 resolution.

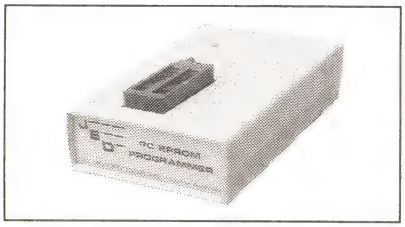
The card's VRAM can be extended from 2MB to 4MB for higher resolutions. By adding the Video XL module, a resolution of 1280 x 1024 at 30 frames per second can be achieved. New PowerDesk 2.0 Windows drivers include full Windows installation, full support of the DCI standard for software video playback, as well as a

**Australian Computers & Peripherals from JED... Call for data sheets.**



The JED AT303/304/305 is a family of 16 to 40 Mhz computers uses 386SX, 486SLC or 486SLXC2 CPUs. It has on-board RAM, PROM or FLASH disks, as well as floppy, IDE and JBUS digital I/O. On board are COM1/2, LPT, KBD. and Mouse ports and optionally COM3 with RS485. Priced from $880 with 1m DRAM. A1 Mbyte FLASH disk is $150.

**$125 PROM Eraser,complete with timer**



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riety of 2D and 3D features for CAD plications.

For further information, circle 165 on e reader service coupon or contact CG Graphic Design, 30 Balfour reet, Chippendale; phone (02) 8 5000.

## ompact scanner r barcodes

A compact, lightweight handheld barode scanner designed to minimise perator fatigue is now available from elxon Australia.

The PSC 5385 weighs 133g, and is ized and shaped for maximum hand omfort with a rugged rubber-encased ose. This makes it suited for use in inustrial, general purpose or point of sale pplications. The scanner is capable of eading high density labels at 2.5cm, nd low density labels at up to 60cm. An integrated marker beam ensures an easy aim in long distance scans, or scanning in bright sunlight.

An adjustable accessory stand and automatic scanning option enables hands-free scanning in busy point-of-sale applications.

The PSC 5385 scanner has an RRP of $1425 including tax.For further information, circle 171 on the reader service coupon or contact Telxon, PO Box 238, Epping 2121; phone (02) 876 7222.

## New printers from Apple

Apple Computer has introduced two new printers; one for mixed- environment office workgroups, the other for the home, education and small business.

The Color Stylewriter 2400 is an inkjet printer priced at $995. It comes ready-to-print out of the box, with 64 TrueType fonts, cable, inks and integrated ColorSync software that supports colour matching and a print quality of 360dpi (dots per inch).

For the office, Apple has introduced the LaserWriter 16/600 PS, a high performance, networked PostScript laser printer. An optional fax card adds high-quality desktop fax send/receive capability. The LaserWriter 16/600 PS has 600dpi resolution enhanced with FinePrint technology for smooth text and line art. It also includes optional support of PhotoGrade for greyscale image enhancement.

The LaserWriter 16/600 PS can handle input from Macintosh, Power Macintosh, Microsoft Windows, DOS and UNIX computer systems, with built-in support for AppleTalk, Novell NetWare, EtherTalk and TCP/IP Ethernet networks. The LaserWriter 16/600 PS is priced at $4995.

For further information, circle 172 on the reader service coupon or contact Apple Computer Australia, 16 Rodborough Road, Frenchs Forest 2086; phone (02) 452 8000.

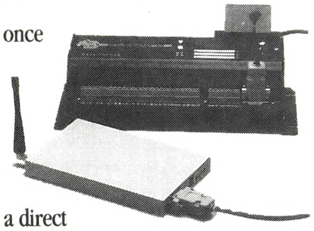
## Quad speed CD-ROM drive is fast

The new XM-3501B from Toshiba is a 5.25 inch half-height drive that has a x4 rotational speed that supports a random access time of 150 milliseconds. The unit has a sequential data transfer rate of 600KB a second.

The high performance is achieved by a series of new high-performance components, including an improved high torque spindle motor, a more sensitive optical pickup and upgraded versions of dedicated ICs for such functions as error correction. Like other Toshiba CD-ROM drives, the new drive has a sealed mechanism, and the enclosed structure prevents dirt getting onto the lens of the laser beam.

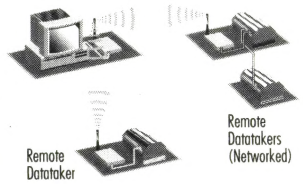
For more information, circle 166 on the reader service coupon or contact Toshiba, 84-92 Talavera Road, North Ryde 2113; phone (02) 887 3201. ❖

Wireless data logging for your PC.



Now you can be in many places at once collecting data and sending it directly to your computer.

A Datataker radio modem system gives you freedom to place your data loggers up to 10 kilometres from your PC. You have the convenience of a direct serial link for downloading collected data, changing programming, and monitoring in real time. Datataker uses sophisticated RF spread-spectrum technology for error-free wireless transmission even in areas of high electrical interference. Ideal for use in factories as well as outdoor applications.



Datataker data loggers give you the choice of up to 150 analog inputs, 84 digital inputs, and 44 digital outputs on a single logger. Cable or radio networking. Direct connection of all common sensors, no extra modules needed. Compatible with all computers, from notebooks to mainframes. PC software included. Data logging has never been this easy.

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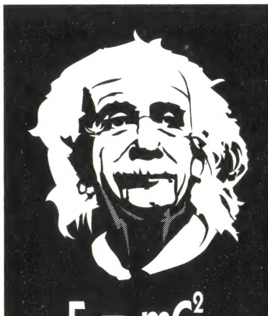

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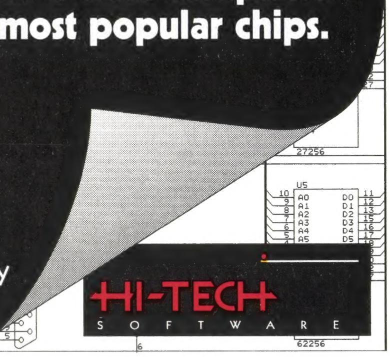

HI-TECH SOFTWARE

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# EA DIRECTORY OF SUPPLIERS

Which of our many advertisers are most likely to be able to sell you that special component, instrument, kit or tool? It's not always easy to decide, because they can't advertise all of their product lines each month. Also some are wholesalers and don't sell to the public. The table below is published as a special service to EA readers, as a guide to the main products sold by our retail advertisers. For address information see the advertisements in this or other recent issues.

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**C PC boards and supplies**
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**E IC chips and semiconductors**
**F Test and measuring instruments**
**G Reference books**

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**HF ELECTRONIC BALLASTS:** Brand new 'slim line' cased electronic ballasts. They provide instant flicker-free starting, extend tube life, reduce power consumption, eliminate flicker during operation (high frequency operation), and are 'noise free' in operation: Their design appears to be similar to that published in S.C. Oct. 94. One models even includes a DIMMING OPTION! Needs external 100K potentiometer or a 0-10V DC source. We have a good but limited stock of these and are offering them at fraction of the cost of their parts! Type A: Designed to power two 32W- 4' tubes, will power two 40W - 4' tubes with no noticable change in light output, has provision for dimming: **$26** Type B: Designed to power two 16W - 18" tubes, will power two 18W - 18" tubes with no noticable change in light output: **$18**

**REEL TO REEL TAPES** New studio quality 13cm-5" Agfa (German) 1/4" reel to reel tapes in original box, 180m-600ft: **$8 ea.**

**WELLER SOLDERING IRON TIPS** New soldering iron tips for low voltage Weller soldering stations and mains operated Weller irons. Mixed popular sizes and temperatures. Specify mains or soldering station type: **5 for $10.**

**HIGH POWER LED IR ILLUMINATOR** This kit includes two PCBs, all on-board components plus casing. Switch mode power supply plus 60 high-intensity 880nm IR (invisible) LEDs. Variable output poower, 6-20V DC input, suitable for illuminating IR responsive CCD cameras, IR night viewers etc. Professional performance at a fraction of the price of commercial products. COMPLETE KIT PRICE: **$60**

**LIGHT MOTION DETECTORS** Small PCB assembly based on a ULN2232 IC. This device has a built-in light detector, and even a siren driver circuit that can drive an external speaker. Will detect humans crossing a narrow corridor at distances up to 3 metres. Much higher ranges are possible if the detector is illuminated by a remote visible or IR light source. Can be used at very low light levels, and even in total darkness: With IR LED. Full information provided. The IC alone is worth $16! OUR SPECIAL PRICE FOR THE ASSEMBLY IS: **$5 ea** or **5 for $20**

**FIBRE OPTIC TUBES** These US made tubes are from used equipment but in excellent condition. Have 25/40mm dia fibre-optically coupled input and output windows. The 25mm tube has an overall diameter of 57mm and is 60 mm long. The 40mm tube has an overall diameter of 80mm and is 92mm long. Their high gain allows them to produce a good image in approximately 1/2 moon illumination, when used with a suitably 'fast' lens, but they can also be IR assisted to see in total darkness. Our HIGH POWER LED IR ILLUMINATOR kit, and the IR filter are both suitable for use with these tubes. The superior resolution of these tubes makes them suitable for low light video pre-amplifiers, wild life observation, and astronomical use. Each tube is supplied with an 9V powered EHT power supply kit. INCREDIBLE PRICES: 25mm intensifier tube and supply kit **$120.** 40mrn intensifier tube and supply kit **$180.** We also have a good supply of the same tubes that may have a small blemish (which is not in the central viewing area). Blemished 25mrn or 40mm intensifier tube and supply kit **ON SPECIAL $50.**

**VIDEO TRANSMITTERS** low power PAL standard UHF transmitters. Have audio and video inputs with adjustable levels, a power switch and a power input socket: 10-14V DC/10mA operation. Enclosed in a small metal box with an attached telescopic antenna. Range is up to 10m with the telescopic antenna supplied, but can be increased to approximately 30m by the use of a small directional UHF antenna. INCREDIBLE PRICING: **$25.**

**TDA ICs/ TRANSFORMERS** We have limited stock of some 20 watt TDA Hi-Fi quality monolithic power amplifier ICs: less than 0.01% THD and TIM distortion, at 10W RMS output! With the transformer we supply we guarantee an output of greater than 20W RMS per channel into an 8 ohm load, with both channels driven. We supply a far over-rated 240V 28V/80W transformer, two TDA1520 ICs, and two suitable PCBs which also include an optional pre-amplifier section (only one additional IC), and a circuit and layout diagram. The combination can be used as a high quality Hi-Fi stereo/guitar/PA amp. Only a handful of additional components are needed to complete this excellent stereo/twin amplifier! Incredible pricing: **$25.** For one 240V-28V (80W!) transformer, two TDA1520 monolithic Hi-Fi amplifier ICs, two PCBs to suit, circuit diagram and layout. Some additional components and a heatsink are required.

**GAS LASER SPECIAL** We have a good supply of some He-Ne laser heads that were removed from new or near new equipment, and have a power output of 2.5-5mW: very bright! With each head we supply a 12V universal laser power supply kit for a ridiculous TOTAL PRICE of: **$89**

**BIGGER LASER** We have a good, but LIMITED QUANTITY of some 'as new' red 6mW+ laser heads that were removed from new equipment. Head dimensions: 45mm dia by 380mm long. With each head we include our 12V Universal Laser power supply. BARGAIN AT **$170** (6mW+ head & supply ITEM No. 0225B.) We can also supply a 240V-12V/4A 5V/4A switch mode power supply to suit for **$30.**

**12V-2.5W SOLAR PANEL SPECIAL** These US made amorphous glass solar panels only need terminating and weather proofing. We provide terminating clips and a slightly larger sheet of glass. The terminated panel is glued to the backing glass, around the edges only. To make the final weatherproof panel look attractive some inexpensive plastic L angle can be glued to the edges with silicone glue. Very easy to make. Dimensions: 305x228mm, Voc: 18-20V, Isc: 250mA. SPECIAL REDUCED PRICE! **$20 ea. or 4 for $60.** Each panel is provided with a sheet of backing glass, terminating clips, isolating diode and instructions. A very efficient switching regulator kit is also available: Suits 12-24V batteries, 0.1-16A panels, **$27.** Also available, a simple and efficient shunt regulator kit, **$5.**

**CCD CAMERA** Monochrome CCD camera which is totally assembled on a small PCB and includes an auto iris lens. It can work with illumination down to 0.1 lux and is IR responsive: can be used in total darkness with infra red illumination. Overall dimensions of camera are 24 x 46 x 70mm and it weighs less than 40 grams! Can be connected to any standard monitor, or the video input of a VCR. ON SPECIAL: **$199**

## SPECIALS BY FAX

If your fax has a polling function, dial **(02) 579 3955** and press your **POLLING** button to get our latest specials, plus our full item and kit listing. Updated 20th each month

**SINGLE-CHANNEL UHF REMOTE CONTROL**: S.C. Dec. 92, 1 x Tx plus 1 x Rx **$45**, extra Tx **$15.**

**4-CHANNEL UHF REMOTE CONTROL KIT:** Two transmitters and one receiver, **$96.**

**GARAGE DOOR - GATE REMOTE CONTROL KIT:** Tx **$18**, Rx **$79.**

**1.5-9V CONVERTER KIT:** **$6** ea. or 3 for **$15.**

**LASER BEAM COMMUNICATOR KIT:** Tx, Rx, plus IR laser, **$60.**

**MAGNETIC CARD READER** Professionally assembled and cased unit that will read information from plastic cards, needs low current 12V DC supply plugpack, **$70.**

**SWITCH MODE POWER SUPPLIES:** Mains in (240V), new assembled units with 12V - 4A and 5V - 4A DC outputs, **$32.**

**ELECTRIC FENCE KIT:** PCB and components, includes prewound transformer, **$40.**

**HIGH POWER IR LEDs**: 880nm / 30mW / 12deg. @ 100mA, **10 for $6**

**PLASMA BALL KIT**: PCB and components kit, needs any 240V light bulb, **$25.**

**MASTHEAD AMPLIFIER KIT**: Two PCBs plus all on-board components: Low noise (uses MAR-6 IC), covers VHF-UHF, **$18.**

**BRAKE LIGHT INDICATOR KIT:** 60 LEDs, two PCBs and ten resistors, makes a very bright 600mm long, high intensity red display, **$30.**

**IEC LEADS:** Heavy duty 3-core (10A) 3m leads with IEC plug on one end and an European plug on the other, **$1.50 ea. or 10 for $10.**

**IEC EXTENSION LEADS**: 2m long, IEC plug at one end, IEC socket at other end, **$5.**

**MOTOR SPECIAL**: These motors can also double up as generators. Type M9: 12V, I no-load = 0.52A - 15,800 RPM at 12V, 36mm dia, 67mm long, **$5.** Type M14: made for slot cars, 4-8V, I no-load = 0.84A at 6V, at max efficiency I = 5.7A - 7500 RPM, 30mm dia, 57mm long, **$5**

**EPROMS**: 27C512, 512K (64K x 8), 150ns access CMOS EPROMs. Removed from new equipment, need to be erased, guaranteed, **$4.**

**40 x 2 LCD DISPLAY**: Brand new 40 character by 2-line LCD displays with built in driver circuitry that uses Hitachi ICs, easy to drive 'standard' displays, brief information provided, **$30 ea. or 4 for $100.**

**12V FANS:** Brand new 80mm 12V - 1.6W DC fans. These are IC controlled and have four different approval stamps, **$10 ea. or 5 for $40.**

**LENSES**: A pair of lens assemblies from brand new laser printers. They contain a total of 4 lenses which by different combinations - placement in a laser beam can diverge, collimate, make a small line, make an ellipse etc. **$8.**

**POLYGON SCANNERS**: Precision motor with 8-sided mirror, plus a matching PCB driver assembly. Will deflect a laser beam and generate a line. Needs a clock pulse and DC supply to operate, information supplied. SPECIAL REDUCED CLEARANCE PRICE **$15.**

**PCB WITH AD7581LN IC**: PCB assembly that among many other components contains a MAXIM AD758ILN IC, 8-bit, 8-channel memory buffered data acquisition system designed to interface with microprocessors, **$29.**

**EHT POWER SUPPLY**; Out of new laser printers, deliver –600V, 7.5kV and +7kV when powered from a 24V-800mA DC supply, enclosed in a plastic case, **$16.**

**MAINS CONTACTOR RELAY**: Has a 24V - 250 ohm relay coil, and four separate SPST switch outputs, 2 x 10A and 2 x 20A, new Omron brand, mounting bracket and spade connectors provided, **$8.**

**ARGON-ION HEADS:** Used Argon-ion heads with 30-100mW output in the blue - green spectrum, will be back in stock soon, priced at around $400 for the `head' only, power supply circuit and information supplied.

**DOME TWEETERS** Small (70mm dia, 15mm deep) dynamic 8 ohm tweeters, as used in very compact high quality speaker systems: **$5 ea.**

**SIEMENS VARISTORS** 420V AC 20 joule varistors suitable for spike protection in Australian 3-phase systems: **10 for $5.**

## OATLEY ELECTRONICS

**PO Box 89, Oatley,**
**NSW 2223**
**Phone (02) 579 4985 Fax**
**(02) 570 7910 or 579 3955**
*major cards accepted with phone and fax orders*
P&P for most mixed orders Aust $6.

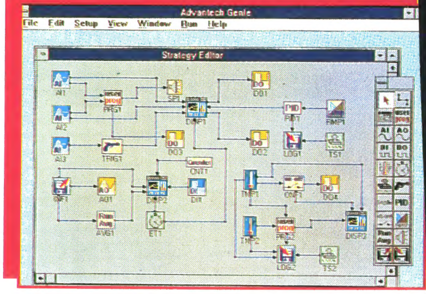
READER INFO NO. 2

# The *Great* DAC DEAL!

## GENIE

### Windows-based Data Acquisition and Control Software

*Features:*

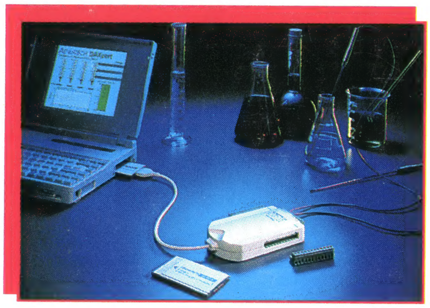


- Object-oriented GUI, no programming required
- Unlimited number of blocks
- 15-20 Hz scan rate with real-time graphic display and data logging
- DLL-based I/O drivers
- Built-in temperature linearization functions
- Alarm, PID and on-off control
- User-programmable logic/calculation functions
- Dynamic Data Exchange (DDE)
- DLL interface for user developed programs
- Context-sensitive help and online error messages

## DACpad-71A/B

### PCMCIA Data Acquisition Card

*Features:*



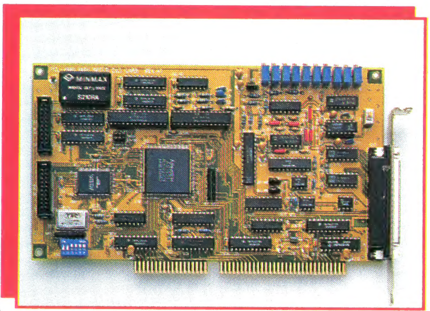
- Meets PCMCIA release 2.01 Low power consumption
- 12-bit ADC, 30 KHz data transfer
- Eight differential input channels
- ±10V or 0-10V input range
- Programmable gain 1, 2, 4, 8 (71A) 1, 10, 100, 1000 (71B)
- 4 digital outputs
- 4 digital inputs
- Daughter board with enclosure and plug-in terminal block included
- C and BASIC drivers included
- CJC and voltage-reference outputs
- Windows DLL Driver optional

Priority Electronics are offering the "**GREAT DAC DEAL**" to introduce **DACpad** to the market. For a limited time we can offer a 40% discount from the **GENIE Software package** (normal list price **$584**) when purchased with DACpad 71A or 71B hardware.

## PCL-1800

### 330 KHz High-speed DAS Card

*Features:*



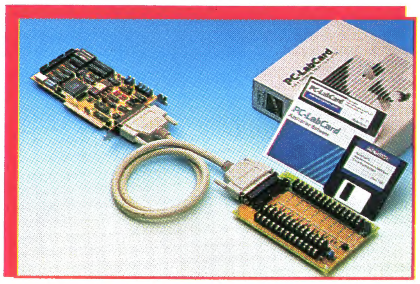
- 330 KHz 12-bit A/D converter
- 16 single-ended or eight differential inputs
- Built-in 1 K word FIFO buffer
- 16-channel analog comparator
- 330 KHz data transfer rate with FIFO
- 200 KHz data transfer rate with DMA
- 12-bit analog output with DMA
- Unipolar/bipolar input with programmable gain
- 16 digital inputs and 16 digital outputs
- Furnished with menu-driven **Scope Software** package

Call **NOW** for the Vol. 41 Data Book that contains all of the **ADVANTECH** range of PC based **Total Solution** products.
**ADVANTECH** - *an ISO-9001 Q.A. Company*

## PCL-818 Series

### High Performance DAS Cards

The **PCL-818H, PCL-818HG** and **PCL-818L** are advanced new versions of the popular PCL-818. Our engineers integrated the functions of the full-size **PCL-818** into a custom 160-pin ASIC chip. This chip gives you maximum accuracy and reliability, along with minimum cost, size and power consumption. The new half-size cards are fully software compatible with the PCL-818. This puts current software support and a wide variety of external signal conditioning boards at your disposal.



### PCL-818 - PCL-818H - PCL-818L

The **PCL-818H** is the enhanced half-size equivalent of the full-size PCL-818. The PCL-818H offers the same functions as the PCL-818 but has a slightly different gain and just one D/A channel. The PCL-**818L** is a low cost version of the PCL-818H. Although it offers all the same functions as the PCL-818H, its sampling rate is lower and only accepts bipolar input. The PCL-818 only has 2 12 bit Analog output channels.

### PCL-818HG

The PCL-818HG is a special high-gain, low-input version of the PCL-818H. Its programmable instrument amplifier (x 0.5, 1, 5, 10, 50, 100, 500 or 1000) lets you acquire very low input signals. An on-board 1 K word FIFO buffer provides faster data transfer and predictable performance under Windows. To reduce noise the PCL-818HG includes DB-37 cable assembly and writing terminal board with CJC (PCLD-8115).

*Features:*

- Either 16 single-ended or eight differential analog inputs.
- Bipolar and unipolar input signals
- Programmable gain on all analog inputs
- 12-bit A/D, up to 100KHz sampling rate with DMA transfer
- One 12-bit analog output channel
- Programmable pacer/counter
- New technology 160 pin 1.0 ohm CMOS ASIC chip on the PCL-818HG, PCL-818H and PCL-818L
- Automatic channel/gain scanning with DMA
- Windows DLL drivers optional

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PE

**Priority Electronics**

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Priority Electronics are an authorised I.B.M. reseller and can offer you the ThinkPad IBM 360 SX33 and IBM 755DX Notebook Computers for unmatched quality, support and reliability.

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